DEPARTMENT OF THE INTERIOR
HUBERT WORK, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 505

# SURFACE WATER SUPPLY OF THE UNITED STATES
## 1919 AND 1920

## PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
W. A. LAMB and W. G. HOYT, District Engineers

Prepared in cooperation with the States of
MINNESOTA, WISCONSIN, IOWA, and ILLINOIS

WASHINGTON
GOVERNMENT PRINTING OFFICE
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# CONTENTS.

## ILLUSTRATIONS.

# SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1919–1920.

## AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the years ending September 30, 1919 and 1920.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

*Provided*, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

*Annual appropriations for the fiscal years ending June 30, 1895–1921.*

| | |
|---|---|
| 1895 | $12,500.00 |
| 1896 | 20,000.00 |
| 1897 to 1900, inclusive | 50,000.00 |
| 1901 to 1902, inclusive | 100,000.00 |
| 1903 to 1906, inclusive | 200,000.00 |
| 1907 | 150,000.00 |
| 1908 to 1910, inclusive | 100,000.00 |
| 1911 to 1917, inclusive | 150,000.00 |
| 1918 | 175,000.00 |
| 1919 | 148,244.10 |
| 1920 | 175,000.00 |
| 1921 | 180,000.00 |

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 9.

Measurements of stream flow have been made at about 5,000 points in the United States and also at many points in Alaska and the

Hawaiian Islands. In July, 1920, 1,350 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time.

## DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

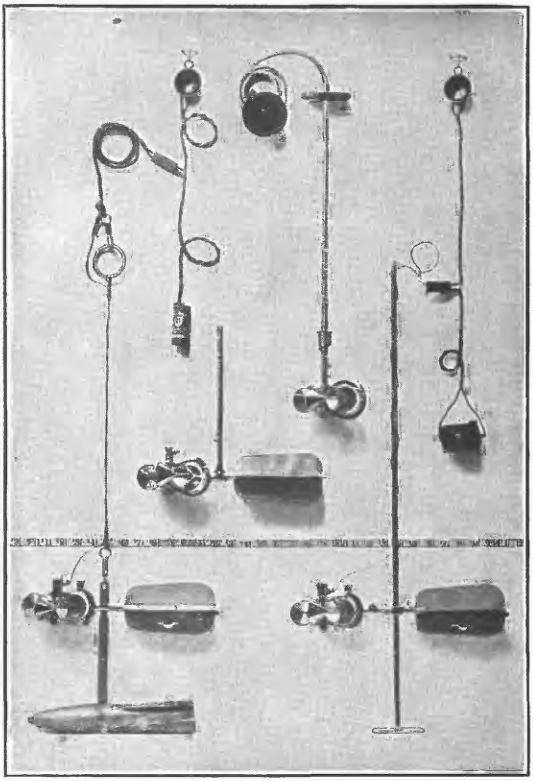
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

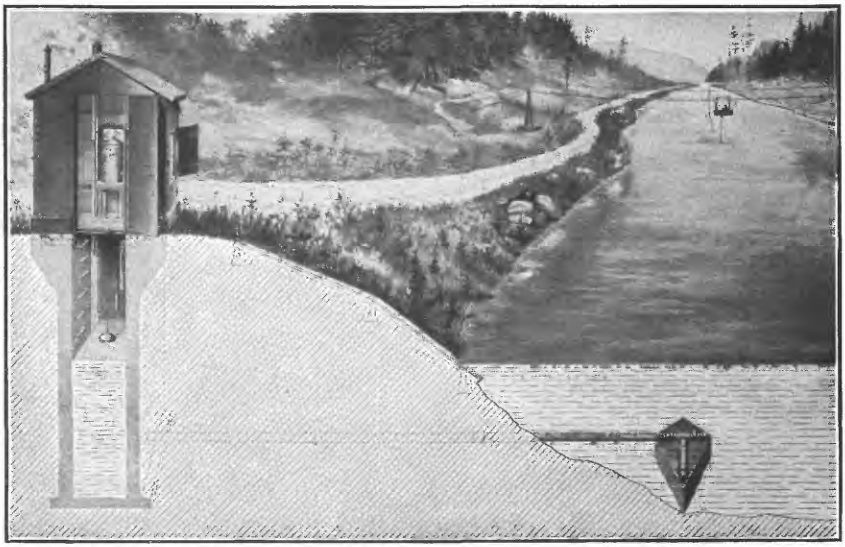
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

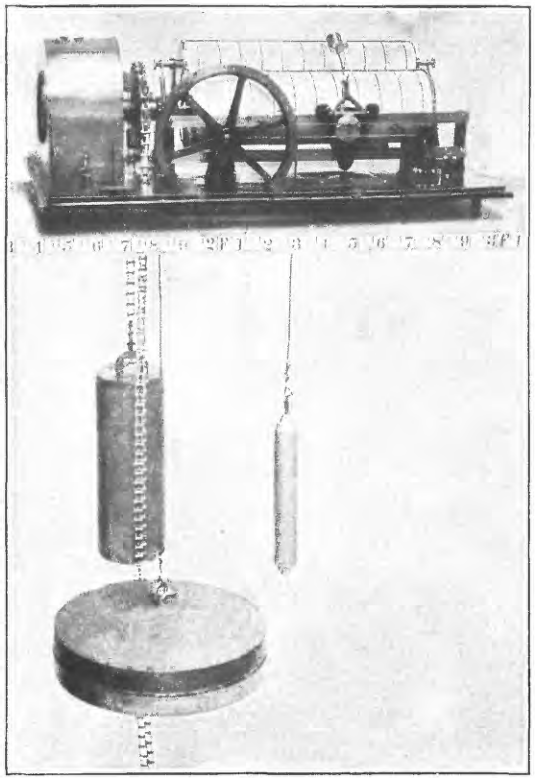
The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the stream would fall if there were no flow.



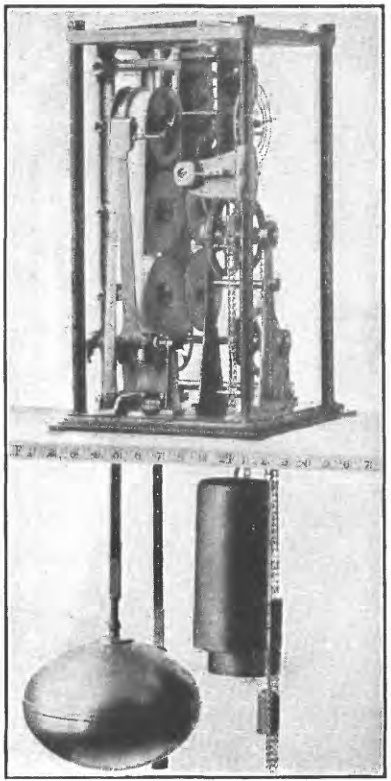
*A*. PRICE CURRENT METERS.



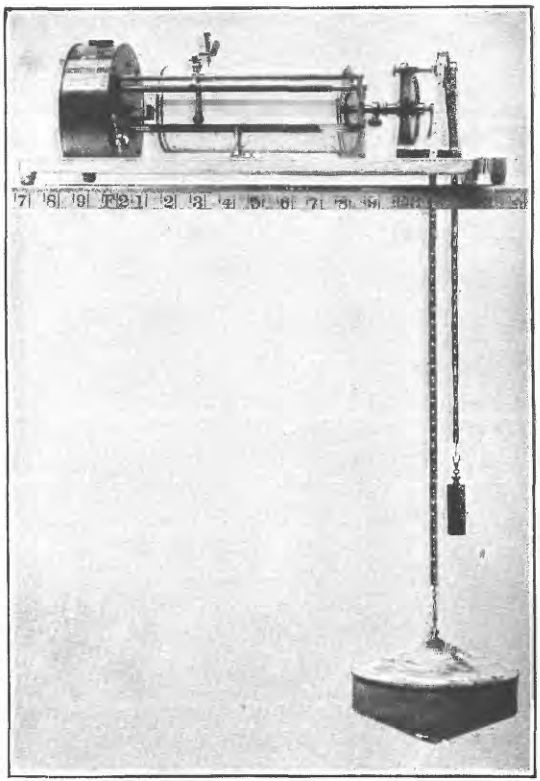
*B*. TYPICAL GAGING STATION.



*A*. STEVENS CONTINUOUS.



*B*. GURLEY PRINTING.



*C*. FRIEZ.

WATER-STAGE RECORDERS.

## EXPLANATION OF DATA.

The data presented in this report cover two years beginning October 1, 1918, and ending September 30, 1920. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals

during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 2, are based.

The deficiency table presented for some of the gaging stations shows the number of days in each year on which the mean daily discharge was less than the discharge given in the table. By subtraction the table gives the number of days each year that the mean daily discharge was between the discharges given in the table and, also by subtraction, the number of days that the mean daily discharge was equal to or greater than the discharge given. If one discharge rating table was used throughout the period covered by the deficiency table, gage heights that correspond to the discharges are also given.

## ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large non-

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53–59, 1916.

contributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off in inches" are therefore not computed if such errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off in inches" previously published by the Survey should be used with caution because of possible inherent but unknown sources of error.

Many gaging stations on streams in the irrigated sections of the United States are located above most of the diversions from those streams, and the discharge recorded does not show the water supply available for further development, as prior appropriations below the stations must first be satisfied. To give an idea of the amount of prior appropriations, a paragraph on diversions is presented in each station description. Where figures are given these can not be considered exact but as being the best information available.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

## PUBLICATIONS.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, professional papers, annual reports, and monographs.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features, as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.

Part IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins; in three volumes:
A. Pacific slope basins in Washington and upper Columbia River basin.
B. Snake River basin.
C. Lower Columbia River basin and Pacific slope basins in Oregon.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Trenton, N. J., State House.
Asheville, N. C., 33–35 Broadway.
Chattanooga, Tenn., 37 Municipal Building.
Columbus, Ohio, Orton Hall, Ohio State University.
Chicago, Ill., 1404 Kimball Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Ames, Iowa, 103 Engineering Hall, Iowa State College.
Rolla, Mo., Rolla Building, School of Mines.
Topeka, Kans., 23 Federal Building.
Helena, Mont., 52 Montana National Bank Building.
Denver, Colo., 403 Post Office Building.
Salt Lake City, Utah, 313 Federal Building.
Idaho Falls, Idaho, 228 Federal Building.
Boise, Idaho, 615 Idaho Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 602 Federal Building.
Tucson, Ariz., 210 Agricultural Building, University of Arizona.
Austin, Tex., State Capitol.
Honolulu, Hawaii, 25 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

Stream-flow records have been obtained at about 5,000 points in the United States, and the data obtained have been published in the reports tabulated below:

*Stream-flow data in reports of the United States Geological Survey.*

[A=Annual Report; B=Bulletin; W=Water-Supply Paper.]

| Report. | Character of data. | Year. |
|---|---|---|
| 10th A, pt. 2 | Descriptive information only | |
| 11th A, pt. 2 | Monthly discharge and descriptive information | 1884 to Sept., 1890. |
| 12th A, pt. 2 | do | 1884 to June 30, 1891. |
| 13th A, pt. 3 | Mean discharge in second-feet | 1884 to Dec. 31, 1892. |
| 14th A, pt. 2 | Monthly discharge (long-time records, 1871 to 1893) | 1888 to Dec. 31, 1893. |
| B 131 | Descriptions, measurements, gage heights, and ratings | 1893 to 1894. |
| 16th A, pt. 2 | Descriptive information only | |
| B 140 | Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years). | 1895. |
| W 11 | Gage heights (also gage heights for earlier years) | 1896. |
| 18th A, pt. 4 | Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years). | 1895 and 1896. |
| W 15 | Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas. | 1897. |
| W 16 | Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States. | 1897. |
| 19th A, pt. 4 | Descriptions, measurements, ratings, and monthly discharge (also some long-time records). | 1897. |
| W 27 | Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River. | 1898. |
| W 28 | Measurements, ratings, and gage heights, Arkansas River and western United States. | 1898. |
| 20th A, pt. 4 | Monthly discharge (also for many earlier years) | 1898. |
| W 35 to 39 | Descriptions, measurements, gage heights, and ratings | 1899. |
| 21st A, pt. 4 | Monthly discharge | 1899. |
| W 47 to 52 | Descriptions, measurements, gage heights, and ratings | 1900. |
| 22d A, pt. 4 | Monthly discharge | 1900. |
| W 65, 66 | Descriptions, measurements, gage heights, and ratings | 1901. |
| W 75 | Monthly discharge | 1901. |
| W 82 to 85 | Complete data | 1902. |
| W 97 to 100 | do | 1903. |
| W 124 to 135 | do | 1904. |
| W 165 to 178 | do | 1905. |
| W 201 to 214 | do | 1906. |
| W 241 to 252 | do | 1907–8. |
| W 261 to 272 | do | 1909. |
| W 281 to 292 | do | 1910. |
| W 301 to 312 | do | 1911. |
| W 321 to 332 | do | 1912. |
| W 351 to 362 | do | 1913. |
| W 381 to 394 | do | 1914. |
| W 401 to 414 | do | 1915. |
| W 431 to 444 | do | 1916. |
| W 451 to 464 | do | 1917. |
| W 471 to 484 | do | 1918 |
| W 501 to 514 | do | 1919 and 1920. |

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1920. The data for any particular station will, in general, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1920, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451, 471, and 501, which contain records for the New England streams from 1903 to 1920. Results of miscellaneous measurements are published by drainage basins.

*Numbers of water-supply papers containing results of stream measurements, 1899–1920.*

| Year. | I North Atlantic slope (St. John River to York River). | II South Atlantic and eastern Gulf of Mexico (James River to the Mississippi). | III Ohio River. | IV St. Lawrence River and Great Lakes. | V Hudson Bay and upper Mississippi River. | VI Missouri River. | VII Lower Mississippi River. | VIII Western Gulf of Mexico. | IX Colorado River. | X Great Basin. | XI Pacific slope in California. | XII North Pacific slope basins. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Pacific slope in Washington and upper Columbia River. | Snake River basin. | Lower Columbia River and Pacific slope in Oregon. |
| 1899 [a] | 35 | [b] 35, 36 | 36 | 36 | 36 | [c] 36, 37 | 37 | 37 | [d] 37, 38 | 38, [e] 39 | 38, [f] 39 | 38 | 38 | 38 |
| 1900 [g] | 47, [h] 48 | 48 | 48, [i] 49 | 49 | 49 | 49, [j] 50 | 50 | 50 | 50 | 51 | 51 | 51 | 51 | 51 |
| 1901 | 65, 75 | 65, 75 | 65, 75 | 65, 75 | [k] 65, 66, 75 | 66, 75 | [k] 65, 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 78 | 66, 75 |
| 1902 | 82 | [b] 82, 83 | 83 | [l] 82, 83 | [k] 83, 85 | 84 | [k] 83, 84 | 84 | 85 | 85 | 85 | 85 | 85 | 85 |
| 1903 | 97 | [b] 97, 98 | 98 | 97 | [k]98,99,[m]100 | 99 | [k] 98, 99 | 99 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1904 | [n] 124, [o] 125, [p] 126 | [p] 126, 127 | 128 | 129 | [k] 128, 130 | 130, [q] 131 | [k] 128, 131 | 132 | 133 | 133, [r] 134 | 134 | 135 | 135 | 135 |
| 1905 | [n] 165, [o] 166, [p] 167 | [p] 167, 168 | 169 | 170 | 171 | 172 | [k] 169, 173 | 174 | 176, [s] 177 | 176, [r] 177 | 177 | 178 | 178 | [t] 177, 178 |
| 1906 | [n] 201, [o] 202, [p] 203 | [p] 203, 204 | 205 | 206 | 207 | 208 | [k] 205, 209 | 210 | 211 | 212, [r] 213 | 213 | 214 | 214 | 214 |
| 1907–8 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250, [r] 251 | 251 | 252 | 252 | 252 |
| 1909 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270, [r] 271 | 271 | 272 | 272 | 272 |
| 1910 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 292 | 292 |
| 1911 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 312 | 312 |
| 1912 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332A | 332B | 332C |
| 1913 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362A | 362B | 362C |
| 1914 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 |
| 1915 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 |
| 1916 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 |
| 1917 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 |
| 1918 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 |
| 1919–20 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 |

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison rivers and Grand River above junction with Gunnison.
[e] Mohave River only
[f] Kings and Kern rivers and south Pacific slope basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

## COOPERATION.

In Montana the work was carried on in cooperation with the United States Reclamation Service. With the exception of the station on St. Mary River near Babb, Mont., all stations in Montana were maintained jointly with the Reclamation Service, Department of the Interior, Canada.

In North Dakota the work was done in cooperation with W. H. Robinson, State engineer, and at certain stations in cooperation with the Bureau of Public Roads, Department of Agriculture, and the Flood Control Commission of North Dakota.

In Minnesota the work at certain stations was carried on in cooperation with the following organizations: International Joint Commission (Kawishiwi River at Winton), United States Weather Bureau (Mississippi River at St. Paul and Minnesota River near Mankato), United States Engineer Corps (Mississippi River at Elk River and Minnesota River near Montevideo), and E. V. Willard, Commissioner, Department of Drainage and Waters (stations in Red River basin).

In Wisconsin the work was carried on in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer; and at certain stations with the Wisconsin-Minnesota Light & Power Co. (Chippewa River at Chippewa Falls, Red Cedar River near Colfax, Red Cedar River at Cedar Falls, and Red Cedar River at Menomonie).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director; the Iowa Highway Commission, F. R. White, chief engineer; and the Mississippi River Power Co. of Keokuk, Iowa, R. H. Bolster, hydraulic engineer. The United States Weather Bureau paid part of the observer's salary at the station on Des Moines River near Boone. The Iowa Railway & Light Co. of Cedar Rapids furnished labor and material for the installation of a water-stage recorder on Cedar River at Cedar Rapids, and the Interstate Power Co. of Chicago, furnished the same for the installation of a recorder on Upper Iowa River near Decorah, and in addition paid for the services of an observer.

In Illinois the work was carried on in cooperation with the Division of Waterways, Department of Public Works and Buildings, W. L. Sackett, superintendent, and at single stations with the United States Engineer Corps (Illinois River at Peoria) and the Central Illinois Public Service Co. (South Fork of Sangamon River at power plant near Taylorville).

## DIVISION OF WORK.

The data for stations in the Hudson Bay basin, in Montana and North Dakota were collected and prepared for publication under the direction of W. A. Lamb, district engineer, Helena, Mont., assisted by E. F. Chandler, B. E. Jones, H. A. Noble, and W. L. Stockwell.

The data for stations in the Hudson Bay and Mississippi River basins in Minnesota were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, by S. B. Soulé and E. F. Chandler, assisted by H. A. Noble, W. L. Stockwell and J. T. Greenberg.

For stations in the Mississippi River basin in Wisconsin the data were collected and prepared for publication under the direction of W. G. Hoyt, assisted by S. B. Soulé, Roy S. Huffman, and J. W. Harris.

For stations in the Mississippi River basin in Iowa the data were collected under the direction of W. G. Hoyt, by E. D. Burchard, engineer in charge, assisted by R. H. Bolster, R. W. Clyde, C. Herlofson, A. Davis, and Neta Riddlesbarger.

The data for stations in the Mississippi River basin in Illinois were collected under the direction of W. G. Hoyt, assisted by H. J. Dean, H. E. Grosbach, and A. M. Wahl.

## GAGING-STATION RECORDS.

### HUDSON BAY DRAINAGE BASIN.

#### ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek.]

LOCATION.—In SE. ¼ sec. 27, T. 36 N., R. 14 W., 1,040 feet above headworks of St. Mary canal and 2 miles south of Babb, on Blackfeet Indian Reservation, in Glacier County.

DRAINAGE AREA.—278 square miles (including area of Swiftcurrent Creek above point of diversion into St. Mary Lake); measured on topographic maps.

RECORDS AVAILABLE.—January 1, 1902, to September 30, 1920. Records for years 1902 to 1917 containing revisions of previously published records are published in Water-Supply Paper 491.

GAGE.—Chain gage on right bank used October 1, 1918, to May 14, 1919, August 23 to September 4, 1919, October 1 to December 7, 1919, and May 14 to September 30, 1920. Stevens water-stage recorder on left bank, installed June 15, 1918, at same datum as chain gage, used May 15 to August 22, 1919. Auxiliary staff gage on right abutment of highway bridge, installed June 14, 1919, used September 5–30, 1919, and December 16, 1919, to May 13, 1920. During winter of 1917 a temporary low-water gage was read, located at site of water-stage recorder. Observer, William Olson.

DISCHARGE MEASUREMENTS.—Made from cable 560 feet below gage. In September, 1909, the cable was moved from a point about 300 feet downstream. Low-water measurements are made by wading about 800 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and cobble stones; practically permanent. Banks high and not subject to overflow. The concrete diversion dam for St. Mary canal, located 1,040 feet below gage, forms the control. The dam is provided with flashboard sluice gates near the canal headgates. Stage-discharge relation is permanent when the flashboards in the sluice gates remain at level of crest of dam and canal headgates are closed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 5.83 feet at noon May 31 (discharge, 4,740 second-feet); minimum flow occurred during the period of maximum ice effect during months of February and March (daily discharge not determined).

Maximum stage recorded during year ending September 30, 1920, 5.31 feet June 17–19 (discharge, 4,010 second-feet); minimum discharge, 88 second-feet March 16–23 and March 29 to April 7 (gage height, 5.05 feet, auxiliary staff gage datum).

1902–1920: Maximum stage estimated 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum stage recorded, 1.0 foot April 3–7, 1904 (discharge, 30 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—Flow is regulated by Sherburne Lake reservoir and natural storage in St. Mary Lakes.

ACCURACY.—Stage-discharge relation affected by ice and by operation of gates of canal. Two fairly well defined rating curves used during 1919, applicable October 1 to April 26 and April 27 to September 4. Rating curve used during 1920, for open channel with gates closed, well defined for both chain gage and auxiliary staff gage. Chain gage read to hundredths once daily October 1, 1918, to May 14, 1919, and August 23 to September 4, 1919, and to tenths once daily October 1, to December 7, 1919, and May 14 to September 30, 1920. Mean daily gage heights May 15 to August 22, 1919, ascertained from Stevens water-stage recorder. Auxiliary staff gage read to quarter-tenths once daily September 5–30, 1919, and December 16, 1919, to May 13, 1920. Daily discharge ascertained by applying daily gage height to rating table except for periods of ice effect and for other periods indicated in footnote to tables of daily discharge. Records good for periods of open water with canal gates closed; other records fair.

The diversion dam below the gaging station was constructed by the United States Reclamation Service for the purpose of diverting water from St. Mary River into St. Mary canal, which carries the water across the divide into North Fork of Milk River. The water then flows in the channel of Milk River through Canada, and is finally used for irrigation in the Milk River Valley in Montana. The present capacity of the diversion canal is about 425 second-feet. A storage reservoir is provided on Swiftcurrent Creek by a dam at the outlet of Sherburne Lake. By means of a diversion channel connecting Swiftcurrent Creek and Lower St. Mary Lake, the run-off from Swiftcurrent Creek is made available for diversion through St. Mary canal.

*Discharge measurements of St. Mary River near Babb, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Dec. 10 | R. F. Edwards | 1.30 | 128 | Aug. 19 | B. E. Jones | 1.90 | 694 |
| 1919. | | | | 22 | W. A. Lamb | 1.89 | 709 |
| Jan. 27 | do | 1.30 | 148 | Sept. 3 | Jones and Dawson [a] | 1.78 | 645 |
| Apr. 15 | W. A Lamb | 1.42 | 199 | 12 | do | 1.60 | 349 |
| May 14 | do | 2.06 | 853 | 20 | B. E. Jones | 1.44 | 240 |
| June 10 | B. E. Jones | 3.01 | 1,430 | 1920. | | | |
| 18 | W. A. Lamb | 2.70 | 1,250 | June 25 | W. A. Lamb | 4.32 | 2,810 |
| July 10 | B. E. Jones | 2.24 | 848 | July 26 | do | 3.70 | 2,170 |
| 26 | W. A. Lamb | 2.20 | 915 | Aug. 6 | H. S. Price | 2.40 | 964 |
| 31 | B. E. Jones | 2.09 | 758 | 25 | W. A. Lamb | 1.72 | 495 |
| Aug. 1 | do | 2.08 | 763 | | | | |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 334 | 358 | 181 | 130 | ..... | ..... | 150 | 1,220 | 3,900 | 1,510 | 834 | 685 |
| 2 | 323 | 358 | 178 | 119 | ..... | ..... | 165 | 1,370 | 3,050 | 1,430 | 840 | 667 |
| 3 | 310 | 317 | 178 | 119 | ..... | ..... | 165 | 1,450 | 2,360 | 1,270 | 840 | 655 |
| 4 | 299 | 299 | 178 | 141 | ..... | ..... | 178 | 1,410 | 1,940 | 1,170 | 853 | 644 |
| 5 | 299 | 299 | 178 | 116 | ..... | ..... | 173 | 1,330 | 1,730 | 1,100 | 853 | 627 |
| 6 | 299 | 299 | 178 | 113 | ..... | ..... | 182 | 1,250 | 1,640 | 1,110 | 834 | 534 |
| 7 | 288 | 299 | 178 | 121 | ..... | ..... | 191 | 1,180 | 1,620 | 1,090 | 814 | 394 |
| 8 | 278 | 311 | 178 | 110 | ..... | ..... | 199 | 1,050 | 1,570 | 1,040 | 801 | 349 |
| 9 | 257 | 257 | 157 | 108 | ..... | ..... | 191 | 1,000 | 1,520 | 970 | 794 | 396 |
| 10 | 246 | 257 | 157 | 106 | ..... | ..... | 191 | 970 | 1,480 | 905 | 775 | 366 |
| 11 | 246 | 257 | 157 | 104 | ..... | ..... | 199 | 905 | 1,390 | 918 | 775 | 344 |
| 12 | 246 | 246 | 157 | 104 | ..... | ..... | 199 | 872 | 1,320 | 957 | 769 | 344 |
| 13 | 257 | 246 | 157 | 120 | ..... | ..... | 199 | 872 | 1,280 | 970 | 769 | 288 |
| 14 | 278 | 257 | 157 | 120 | ..... | ..... | 199 | 827 | 1,240 | 970 | 757 | 295 |
| 15 | 278 | 257 | 157 | 120 | ..... | ..... | 199 | 814 | 1,190 | 964 | 751 | 277 |
| 16 | 288 | 272 | 157 | 138 | ..... | ..... | 208 | 840 | 1,190 | 957 | 751 | 277 |
| 17 | 358 | 272 | 157 | 128 | ..... | ..... | 222 | 892 | 1,220 | 957 | 745 | 271 |
| 18 | 358 | 272 | 157 | 128 | ..... | ..... | ..... | 918 | 1,250 | 944 | 709 | 255 |
| 19 | 371 | 272 | 157 | 128 | ..... | ..... | ..... | 998 | 1,280 | 924 | 703 | 249 |
| 20 | 410 | 246 | 157 | 128 | ..... | ..... | ..... | 1,140 | 1,340 | 918 | 703 | 242 |
| 21 | 410 | 238 | 157 | 128 | ..... | ..... | ..... | 1,410 | 1,390 | 918 | 709 | 239 |
| 22 | 423 | 215 | 157 | 138 | ..... | ..... | ..... | 1,810 | 1,490 | 924 | 709 | 237 |
| 23 | 423 | 202 | 150 | 120 | ..... | ..... | ..... | 2,260 | 1,550 | 957 | 739 | 235 |
| 24 | 410 | 205 | 150 | 114 | ..... | ..... | ..... | 2,690 | 1,570 | 964 | 733 | 234 |
| 25 | 410 | 182 | 150 | 120 | ..... | ..... | ..... | 2,940 | 1,550 | 957 | 727 | 222 |
| 26 | 410 | 187 | 150 | 138 | ..... | ..... | ..... | 3,110 | 1,530 | 931 | 709 | 221 |
| 27 | 390 | 180 | 146 | 148 | ..... | ..... | 545 | 3,450 | 1,580 | 924 | 721 | 228 |
| 28 | 390 | 185 | 152 | 141 | ..... | ..... | 715 | 3,870 | 1,640 | 905 | 715 | 228 |
| 29 | 390 | 189 | 151 | 144 | ..... | ..... | 840 | 4,350 | 1,630 | 886 | 709 | 228 |
| 30 | 390 | 182 | 145 | 149 | ..... | ..... | 1,000 | 4,620 | 1,600 | 866 | 703 | 243 |
| 31 | 378 | ..... | 143 | 149 | ..... | ..... | ..... | 4,420 | ..... | 853 | 703 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 218 | ..... | ..... | 149 | 190 | 108 | 88 | 297 | 1,400 | 1,970 | 1,480 | 493 |
| 2 | 204 | ..... | ..... | 149 | 190 | 108 | 88 | 297 | 1,310 | 2,080 | 1,670 | 423 |
| 3 | 208 | ..... | ..... | 149 | 172 | 100 | 88 | 324 | 1,130 | 2,190 | 1,670 | 423 |
| 4 | 204 | ..... | ..... | 134 | 159 | 100 | 88 | 342 | 1,260 | 2,290 | 1,570 | 358 |
| 5 | 199 | ..... | ..... | 118 | 159 | 92 | 88 | 324 | 1,310 | 2,190 | 1,220 | 358 |
| 6 | 199 | ..... | ..... | 118 | 149 | 92 | 88 | 342 | 1,580 | 2,080 | 966 | 358 |
| 7 | 191 | ..... | ..... | 118 | 149 | 92 | 88 | 361 | 1,870 | 1,860 | 966 | 358 |
| 8 | 182 | ..... | ..... | 108 | 149 | 92 | 96 | 442 | 2,390 | 1,770 | 680 | 358 |
| 9 | 191 | ..... | ..... | 108 | 149 | 92 | 96 | 556 | 2,820 | 1,670 | 750 | 299 |
| 10 | 182 | ..... | ..... | 108 | 149 | 100 | 96 | 715 | 3,050 | 1,480 | 750 | 299 |
| 11 | 165 | ..... | ..... | 108 | 149 | 100 | 100 | 864 | 3,160 | 1,480 | 750 | 299 |
| 12 | 157 | ..... | ..... | 108 | 149 | 108 | 108 | 1,030 | 3,280 | 1,480 | 966 | 299 |
| 13 | 157 | ..... | ..... | 108 | 134 | 108 | 123 | 1,140 | 3,380 | 1,570 | 1,040 | 358 |
| 14 | 150 | 138 | ..... | 108 | 134 | 100 | 108 | 1,050 | 3,380 | 1,570 | 1,120 | 423 |
| 15 | 150 | 138 | ..... | 108 | 134 | 100 | 123 | 1,220 | 3,620 | 1,570 | 1,120 | 718 |
| 16 | 146 | 150 | 159 | 108 | 134 | 88 | 128 | 1,350 | 3,750 | 1,670 | 966 | 958 |
| 17 | 142 | 150 | 134 | 108 | 123 | 88 | 123 | 1,690 | 4,010 | 1,870 | 822 | 878 |
| 18 | 135 | 157 | 134 | 108 | 118 | 88 | 134 | 1,900 | 4,010 | 2,190 | 680 | 878 |
| 19 | 127 | 157 | 96 | 108 | 118 | 88 | 149 | 2,110 | 4,010 | 2,300 | 613 | 878 |
| 20 | 127 | 165 | 108 | 118 | 118 | 88 | 134 | 2,330 | 3,880 | 2,300 | 479 | 958 |
| 21 | 119 | 165 | 118 | 118 | 118 | 88 | 159 | 2,330 | 3,620 | 2,190 | 479 | 878 |
| 22 | 111 | 170 | 118 | 134 | 118 | 88 | 178 | 2,330 | 3,510 | 2,190 | 613 | 798 |
| 23 | 103 | 182 | 108 | 134 | 118 | 88 | 190 | 2,220 | 3,510 | 2,190 | 590 | 798 |
| 24 | 95 | ..... | 108 | 134 | 108 | 96 | 209 | 2,220 | 3,280 | 2,190 | 553 | 718 |
| 25 | ..... | ..... | 108 | 134 | 108 | 96 | 209 | 2,090 | 2,820 | 2,190 | 479 | 718 |
| 26 | ..... | ..... | 118 | 134 | 108 | 96 | 222 | 1,980 | 2,380 | 2,190 | 493 | 643 |
| 27 | ..... | ..... | 134 | 134 | 108 | 96 | 222 | 1,980 | 2,070 | 2,080 | 553 | 643 |
| 28 | ..... | ..... | 149 | 149 | 108 | 96 | 260 | 1,770 | 1,860 | 1,980 | 493 | 568 |
| 29 | ..... | ..... | 190 | 149 | 108 | 88 | 275 | 1,670 | 1,860 | 1,480 | 493 | 568 |
| 30 | ..... | ..... | 190 | 149 | ..... | 88 | 275 | 1,490 | 1,860 | 1,480 | 493 | 568 |
| 31 | ..... | ..... | 172 | 159 | ..... | 88 | ..... | 1,400 | ..... | 1,300 | 493 | ..... |

NOTE.—Stage-discharge relation slightly affected by ice Nov. 21 to Dec. 1, Dec. 27 to Jan. 10 and Jan. 27–31, 1919; discharge ascertained by comparison with flow of St. Mary River near Kimball, Alberta. Stage-discharge relation seriously affected by ice Feb. 1 to Mar. 31, 1919; mean discharge estimated 110 second-feet during February and 100 second-feet during March by comparison with flow of St. Mary River near Kimball, Alberta. Mean discharge Apr. 18–26, 1919, estimated at 400 second-feet by comparison with flow of St. Mary River near Kimball, Alberta, plus flow in canal at intake. Discharge Sept. 5–30, 1919, ascertained by applying daily gage height to rating table and adding flow in canal at intake for each day. Stage-discharge relation affected by ice and by heavy draft in canal Oct. 21–24, 1919; discharge estimated. Mean discharge estimated because of ice, as follows: Oct. 25–31, 1919, 90 second-feet; Nov. 1–13, 1919, 100 second-feet; Nov. 24–30, 1919, 150 second-feet; Dec. 1–15, 1919, 120 second-feet. Stage-discharge relation may have been slightly affected by ice at times during January and February, 1920, but open-water rating was used. Discharge Oct. 1–20, 1919, May 25 to June 14 and June 22 to Aug. 27, 1920, ascertained by applying a correction to daily gage height for effect of gate opening in canal and then applying corrected daily gage height to rating table.

*Monthly discharge of St. Mary River near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918-19. | | | | |
| October | 423 | 246 | 337 | 20,700 |
| November | 358 | 180 | 254 | 15,100 |
| December | 181 | 143 | 160 | 9,840 |
| January | 149 | 104 | 125 | 7,690 |
| February | ..... | ..... | 110 | 6,110 |
| March | ..... | ..... | 100 | 6,150 |
| April | 1,000 | 150 | 330 | 19,600 |
| May | 4,620 | 814 | 1,810 | 111,000 |
| June | 3,900 | 1,190 | 1,630 | 97,000 |
| July | 1,510 | 853 | 1,010 | 62,100 |
| August | 853 | 703 | 760 | 46,700 |
| September | 685 | 221 | 349 | 20,800 |
| The year | 4,620 | ..... | 585 | 423,000 |
| 1919-20. | | | | |
| October | 218 | ..... | 145 | 8,920 |
| November | 182 | ..... | 131 | 7,800 |
| December | 190 | 96 | 127 | 7,810 |
| January | 159 | 108 | 125 | 7,690 |
| February | 190 | 108 | 135 | 7,760 |
| March | 108 | 88 | 94.8 | 5,830 |
| April | 275 | 88 | 144 | 8,570 |
| May | 2,330 | 297 | 1,300 | 79,900 |
| June | 4,010 | 1,130 | 2,710 | 161,000 |
| July | 2,300 | 1,300 | 1,900 | 117,000 |
| August | 1,670 | 479 | 839 | 51,600 |
| September | 958 | 299 | 576 | 34,300 |
| The year | 4,010 | ..... | 687 | 498,000 |

### ST. MARY RIVER NEAR KIMBALL, ALBERTA.

LOCATION.—In SW. ¼ sec. 25, T. 1 N., R. 25 W. fourth meridian, 1 mile south and 1 mile west of Kimball, Alberta, and 5 miles north of international boundary.

DRAINAGE AREA.—472 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1920. From September 1, 1902, to December 31, 1912, records were obtained at a point half a mile north of the boundary line, and are published in the water-supply papers under the heading "St. Mary River near Cardston, Alberta," except in Water-Supply Paper 491 in which they are published, with revisions, under the heading "St. Mary River at Cook's ranch, Alberta, near international boundary." A station was maintained by the Alberta Railway & Irrigation Co. at a point half a mile below the present station, from 1905 to 1908. It was taken over by the Irrigation Branch (now the Reclamation Service), Department of the Interior, Canada, in April, 1908, and operated until December 31, 1912. The records for this period are published in Water-Supply Paper 491 under the heading "St. Mary River near Kimball, Alberta, near international boundary." The discharge at the three points is practically the same.

GAGE.—Stevens water-stage recorder with a concrete well and shelter on right bank used during open-water season. During winter a chain gage, attached to the highway bridge 3 miles below the station is used. A staff gage at cable from which measurements were made was used from October 1, 1917, to November 8, 1917. Observer, J. M. Dunn.

DISCHARGE MEASUREMENTS.—Made from a cable 1,200 feet above gage; low-water measurements made by wading near gage.

CHANNEL AND CONTROL.—Bed of stream at gage and at control composed of boulders and sandstone ledges. Control is formed by an outcropping ledge of sandstone covered with boulders near left bank.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, from water-stage recorder, 6.13 feet at 11 a. m. May 30 (discharge, 4,380 second-feet); minimum discharge, estimated 59 second-feet March 3 (stage-discharge relation affected by ice).

Maximum stage during year ending September 30, 1920, from water-stage recorder, 6.28 feet at 2 p. m. June 18 (discharge, 4,600 second-feet); minimum discharge, estimated 46 second-feet December 1 (stage-discharge relation affected by ice).

1902–1920: Maximum discharge, 18,000 second-feet, June 5, 1908, estimated from the crest stage at the station at Cook's ranch, Alberta, by comparison with record for station near Babb; minimum discharge, estimated 46 second-feet [2] December 1, 1919 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSIONS.—The St. Mary canal, constructed by the United States Reclamation Service, diverts water from St. Mary River near Babb, Mont., to the North Fork of Milk River. Approximately 141,000 acre-feet were diverted during 1919 and about 72,000 acre-feet during 1920. The Alberta Railway & Irrigation Co.'s canal diverts water from St. Mary River about 2 miles below the station.

REGULATION.—The flow of Swiftcurrent Creek is regulated by the Sherburne Lake reservoir.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shifting control. Four rating curves used during open-water periods are well defined; applicable October 1 to November 20, 1918, April 17, 1919, to October 20, 1919, April 22 to June 18, 1920, and June 19 to September 30, 1920. Daily gage heights obtained from Stevens water-stage recorder records by straight-line method October 1 to December 30, 1918, April 1 to October 23, 1919, April 22 to May 2, 1920, May 4–6, 1920, and May 14 to September 30, 1920. Daily gage heights during periods January 1 to March 31, 1919, October 24, 1919, to April 21, 1920, and May 8–12, 1920, from observer's readings once daily to hundredths on chain gage at highway bridge 3 miles below water-stage recorder. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Records good.

COOPERATION.—Station maintained in cooperation with the Reclamation Service, Department of the Interior, Canada.

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[2] Only estimates of mean monthly flow are available for the winter periods from 1902 to 1912, inclusiv , and a lower minimum discharge may have occurred during that time.

*Discharge measurements of St. Mary River near Kimball, Alberta, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 14 | C. H. Ellacott[a] | 2.70 | 343 | Aug. 12 | C. F. Corbett | 2.87 | 432 |
| 24 | do | 2.98 | 439 | 18 | B. E. Jones | 2.74 | 355 |
| Nov. 11 | do | 2.47 | 244 | 28 | Dawson[a] and Jones | 2.69 | 344 |
| 18 | do | 2.61 | 294 | Sept. 6 | C. F. Corbett | 2.65 | 332 |
| Dec. 3 | do | [b] 2.33 | 192 | 23 | S. G. Dawson | 2.24 | 203 |
| 6 | do | [b] 2.29 | 193 | 28 | Corbett and Ford[a] | 2.30 | 199 |
| 28 | do | [b] 3.22 | 155 | Oct. 4 | O. H. Hoover[c] | 2.12 | 174 |
| 1919. | | | | 18 | do | 1.91 | 121 |
| Jan. 5 | do | 5.74 | 132 | Nov. 13 | do | 4.35 | 122 |
| 20 | Newhall[a] and Ellacott | 5.24 | 149 | Dec. 3 | Hoover and McLean[c] | 5.13 | 103 |
| 27 | C. H. Ellacott | 5.28 | 186 | 22 | H. J. McLean | 5.04 | 196 |
| 28 | R. F. Edwards | 5.32 | 180 | 1920. | | | |
| Feb. 10 | C. H. Ellacott | 5.08 | 183 | Jan. 13 | do | 5.13 | 173 |
| 16 | do | 5.05 | 159 | Feb. 2 | do | 5.79 | 226 |
| Mar. 8 | A. W. P. Lowrie[a] | 4.94 | 122 | 23 | do | 5.48 | 151 |
| 18 | do | 5.20 | 132 | Mar. 17 | do | 5.62 | 136 |
| 27 | C. H. Ellacott | 5.08 | 134 | Apr. 2 | do | 4.88 | 104 |
| 31 | do | 5.20 | 285 | 19 | do | 5.15 | 887 |
| Apr. 8 | do | [b] 2.44 | 236 | May 15 | A. W. P. Lowrie[c] | 4.54 | 1,739 |
| 15 | W. A. Lamb | [b] 2.40 | 243 | 23 | W. A. Lamb | 5.24 | 2,630 |
| 21 | C. H. Ellacott | 2.25 | 200 | June 7 | A. W. P. Lowrie | 4.75 | 1,862 |
| 22 | do | 2.05 | 148 | 23 | Lowrie and Lamb | 5.74 | 3,610 |
| 24 | do | 1.92 | 127 | 23 | A. W. P. Lowrie | 5.80 | 3,698 |
| May 16 | Corbett[a] and Newhall | 3.14 | 554 | July 28 | W. A. Lamb | 4.48 | 1,710 |
| 29 | C. F. Corbett | 6.05 | 4,229 | Aug. 1 | A. W. P. Lowrie | 3.94 | 1,193 |
| June 14 | do | 3.75 | 985 | 8 | Price and Lamb | 3.06 | [d] 521 |
| July 5 | do | 3.46 | 743 | 18 | S. G. Dawson[a] | 3.02 | 486 |
| 24 | do | 3.20 | 599 | Sept. 25 | A. W. P. Lowrie | 3.46 | 740 |
| Aug. 1 | B. E. Jones | 2.98 | 463 | | | | |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation affected by ice; gage height from staff gage at regular section.
[c] Engineer, Water Power Branch, Department of the Interior, Canada.
[d] Measurement made by wading below Alberta Railway & Irrigation Co.'s canal intake; flow in canal (472 second-feet) included in result.

NOTE.—Stage-discharge relation affected by ice during periods January to March, 1919, and Oct. 24, 1919, to Apr. 21, 1920. Measurements during these periods referred to chain gage on highway bridge 3 miles below water-stage recorder.

*Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 377 | 352 | 195 | 139 | 172 | 77 | 272 | 994 | 3,584 | 1,246 | 466 | 330 |
| 2 | 364 | 352 | 190 | 129 | 171 | 68 | 286 | 1,112 | 2,902 | 1,112 | 466 | 299 |
| 3 | 352 | 324 | 190 | 131 | 170 | 59 | 292 | 1,162 | 2,206 | 978 | 470 | 296 |
| 4 | 348 | 316 | 197 | 154 | 174 | 67 | 296 | 1,153 | 1,790 | 833 | 480 | 292 |
| 5 | 340 | 297 | 197 | 131 | 179 | 75 | 263 | 1,072 | 1,564 | 752 | 475 | 375 |
| 6 | 336 | 283 | 192 | 129 | 177 | 115 | 243 | 1,001 | 1,474 | 752 | 470 | 326 |
| 7 | 332 | 286 | 176 | 139 | 174 | 131 | 240 | 962 | 1,436 | 737 | 457 | 269 |
| 8 | 328 | 276 | 169 | 129 | 178 | 121 | 235 | 871 | 1,398 | 701 | 452 | 233 |
| 9 | 312 | 268 | 160 | 119 | 182 | 121 | 235 | 803 | 1,360 | 645 | 434 | 292 |
| 10 | 304 | 276 | 135 | 129 | 182 | 123 | 246 | 737 | 1,281 | 559 | 421 | 260 |
| 11 | 304 | 254 | 164 | 135 | 182 | 123 | 249 | 652 | 1,195 | 559 | 417 | 289 |
| 12 | 324 | 241 | 164 | 125 | 163 | 95 | 252 | 613 | 1,096 | 594 | 413 | 272 |
| 13 | 316 | 258 | 153 | 115 | 137 | 119 | 258 | 581 | 1,025 | 607 | 408 | 263 |
| 14 | 336 | 258 | 169 | 125 | 138 | 79 | 258 | 531 | 970 | 619 | 404 | 292 |
| 15 | 348 | 261 | 148 | 139 | 140 | 97 | 243 | 510 | 931 | 587 | 400 | 266 |
| 16 | 390 | 276 | 182 | 137 | 159 | 119 | 238 | 542 | 924 | 581 | 387 | 240 |
| 17 | 412 | 290 | 171 | 137 | 148 | 140 | 246 | 587 | 970 | 587 | 375 | 225 |
| 18 | 452 | 294 | 151 | 150 | 131 | 131 | 246 | 645 | 1,001 | 581 | 366 | 214 |
| 19 | 521 | 279 | 141 | 150 | 115 | 129 | 166 | 737 | 1,025 | 564 | 358 | 217 |
| 20 | 566 | 261 | 156 | 150 | 109 | 113 | 180 | 962 | 1,064 | 553 | 358 | 220 |
| 21 | 540 | 248 | 141 | 157 | 103 | 131 | 207 | 1,263 | 1,137 | 559 | 362 | 227 |
| 22 | 521 | 225 | 182 | 159 | 91 | 131 | 173 | 1,607 | 1,229 | 559 | 362 | 220 |
| 23 | 484 | 212 | 145 | 163 | 80 | 125 | 138 | 2,176 | 1,289 | 575 | 362 | 217 |
| 24 | 452 | 215 | 124 | 189 | 69 | 119 | 134 | 2,612 | 1,307 | 575 | 358 | 207 |
| 25 | 441 | 192 | 143 | 182 | 69 | 99 | 147 | 2,850 | 1,298 | 553 | 346 | 204 |
| 26 | 436 | 197 | 151 | 184 | 69 | 109 | 225 | 3,008 | 1,263 | 553 | 350 | 222 |
| 27 | 426 | 190 | 148 | 186 | 60 | 133 | 289 | 3,300 | 1,238 | 553 | 342 | 227 |
| 28 | 408 | 195 | 155 | 179 | 68 | 154 | 342 | 3,798 | 1,254 | 536 | 342 | 233 |
| 29 | 403 | 199 | 155 | 182 | ..... | 184 | 564 | 4,110 | 1,307 | 510 | 338 | 217 |
| 30 | 372 | 192 | 151 | 187 | ..... | 234 | 826 | 4,306 | 1,307 | 500 | 328 | 217 |
| 31 | 360 | ..... | 140 | 191 | ..... | 285 | ..... | 4,052 | ..... | 490 | 326 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 207 | 154 | 46 | 196 | 226 | 129 | 347 | 472 | 1,344 | 1,927 | 1,144 | 485 |
| 2 | 200 | 129 | 60 | 218 | 226 | 119 | 104 | 416 | 1,270 | 2,118 | 1,335 | 490 |
| 3 | 187 | 127 | 103 | 201 | 257 | 129 | 107 | 476 | 1,191 | 2,200 | 1,405 | 495 |
| 4 | 175 | 113 | 97 | 201 | 321 | 125 | 135 | 535 | 1,108 | 2,226 | 1,395 | 462 |
| 5 | 168 | 140 | 101 | 206 | 325 | 115 | 148 | 681 | 1,297 | 2,118 | 1,125 | 449 |
| 6 | 156 | 105 | 127 | 189 | 340 | 111 | 170 | 918 | 1,486 | 2,066 | 817 | 436 |
| 7 | 147 | 125 | 123 | 177 | 355 | 127 | 170 | 1,188 | 1,761 | 1,939 | 620 | 416 |
| 8 | 156 | 113 | 133 | 189 | 359 | 172 | 194 | 1,458 | 2,266 | 1,691 | 515 | 408 |
| 9 | 150 | 111 | 139 | 201 | 367 | 204 | 234 | 1,353 | 2,925 | 1,530 | 490 | 400 |
| 10 | 150 | 131 | 142 | 189 | 325 | 236 | 234 | 1,191 | 3,324 | 1,468 | 530 | 392 |
| 11 | 150 | 131 | 152 | 165 | 283 | 228 | 234 | 1,288 | 3,457 | 1,405 | 535 | 384 |
| 12 | 147 | 131 | 142 | 165 | 277 | 209 | 300 | 1,693 | 3,590 | 1,446 | 620 | 380 |
| 13 | 138 | 111 | 119 | 172 | 267 | 209 | 481 | 1,676 | 3,628 | 1,658 | 757 | 380 |
| 14 | 130 | 111 | 123 | 212 | 248 | 375 | 886 | 1,660 | 3,780 | 1,572 | 809 | 436 |
| 15 | 123 | 131 | 172 | 283 | 236 | 109 | 750 | 1,761 | 3,989 | 1,499 | 809 | 650 |
| 16 | 123 | 137 | 194 | 251 | 225 | 152 | 730 | 1,807 | 4,255 | 1,572 | 778 | 841 |
| 17 | 125 | 137 | 194 | 209 | 186 | 136 | 840 | 2,090 | 4,331 | 1,691 | 620 | 942 |
| 18 | 125 | 137 | 206 | 196 | 194 | 140 | 875 | 2,424 | 4,445 | 1,915 | 500 | 933 |
| 19 | 121 | 135 | 206 | 196 | 191 | 140 | 887 | 2,475 | 4,218 | 2,200 | 428 | 908 |
| 20 | 119 | 152 | 206 | 79 | 133 | 234 | 570 | 2,614 | 3,904 | 2,213 | 368 | 899 |
| 21 | 106 | 152 | 219 | 87 | 165 | 467 | 300 | 2,758 | 3,813 | 2,172 | 304 | 942 |
| 22 | 106 | 222 | 194 | 67 | 165 | 518 | 332 | 2,740 | 3,633 | 1,988 | 420 | 899 |
| 23 | 104 | 300 | 196 | 49 | 150 | 497 | 350 | 2,650 | 3,633 | 1,939 | 467 | 849 |
| 24 | 115 | 462 | 251 | 48 | 157 | 508 | 392 | 2,758 | 3,525 | 1,927 | 462 | 801 |
| 25 | 130 | 513 | 270 | 154 | 140 | 434 | 372 | 2,424 | 2,867 | 1,903 | 449 | 743 |
| 26 | 159 | 355 | 317 | 219 | 150 | 351 | 372 | 2,148 | 2,452 | 1,903 | 472 | 676 |
| 27 | 158 | 209 | 310 | 201 | 123 | 351 | 548 | 1,930 | 2,053 | 1,819 | 476 | 608 |
| 28 | 157 | 60 | 320 | 212 | 133 | 371 | 724 | 1,715 | 1,879 | 1,724 | 568 | 568 |
| 29 | 157 | 60 | 267 | 206 | 123 | 379 | 562 | 1,515 | 1,855 | 1,446 | 546 | 602 |
| 30 | 157 | 60 | 222 | 231 | ..... | 355 | 520 | 1,420 | 1,831 | 1,315 | 557 | 574 |
| 31 | 157 | ..... | 184 | 228 | ..... | 404 | ..... | 1,362 | ..... | 1,125 | 525 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 21, 1918, to Apr. 16, 1919, and Oct. 21, 1919, to Apr. 21, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Discharge interpolated on account of lack of gage readings Dec. 31, 1918; Jan. 3, 8, 12, 19, 26, 30, Feb. 2, 6, 8, 14, 18, 20, 22, 23, 25, 28, Mar. 2, 4, 9, 16, 23, 30, Oct. 27, 29, 1919; and Apr. 10, 27, May 3, 7, 13, 1920. Discharge estimated on account of lack of gage readings Feb. 9, Mar. 11, and Oct. 24, 25, 31, 1919.

*Monthly discharge of St. Mary River near Kimball, Alberta, for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19. | | | | |
| October | 566 | 304 | 394 | 24,200 |
| November | 352 | 190 | 259 | 15,400 |
| December | 197 | 124 | 162 | 9,960 |
| January | 191 | 115 | 150 | 9,220 |
| February | 182 | 60 | 135 | 7,500 |
| March | 285 | 59 | 123 | 7,560 |
| April | 826 | 134 | 266 | 15,800 |
| May | 4,306 | 510 | 1,590 | 97,800 |
| June | 3,584 | 924 | 1,390 | 82,700 |
| July | 1,246 | 490 | 649 | 39,900 |
| August | 480 | 326 | 396 | 24,300 |
| September | 375 | 204 | 255 | 15,200 |
| The year | 4,306 | 59 | 483 | 350,000 |
| 1919–20. | | | | |
| October | 207 | 104 | 145 | 8,920 |
| November | 513 | 60 | 165 | 9,820 |
| December | 320 | 46 | 179 | 11,000 |
| January | 283 | 48 | 181 | 11,100 |
| February | 367 | 123 | 229 | 13,200 |
| March | 518 | 111 | 259 | 15,900 |
| April | 887 | 104 | 429 | 25,500 |
| May | 2,758 | 416 | 1,660 | 102,000 |
| June | 4,445 | 1,108 | 2,840 | 169,000 |
| July | 2,226 | 1,125 | 1,800 | 111,000 |
| August | 1,405 | 304 | 672 | 41,300 |
| September | 942 | 380 | 615 | 36,600 |
| The year | 4,445 | 46 | 764 | 555,000 |

*Combined daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, and St. Mary canal at St. Mary crossing, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 377 | 352 | 195 | 139 | 172 | 77 | 272 | 1,349 | 3,973 | 1,626 | 854 | 719 |
| 2 | 364 | 352 | 190 | 129 | 171 | 68 | 286 | 1,480 | 3,290 | 1,494 | 854 | 686 |
| 3 | 352 | 324 | 190 | 131 | 170 | 59 | 292 | 1,534 | 2,594 | 1,361 | 859 | 682 |
| 4 | 348 | 316 | 197 | 154 | 174 | 67 | 296 | 1,541 | 2,179 | 1,215 | 869 | 677 |
| 5 | 340 | 297 | 197 | 131 | 179 | 75 | 263 | 1,466 | 1,955 | 1,136 | 861 | 697 |
| 6 | 336 | 283 | 192 | 129 | 177 | 115 | 243 | 1,399 | 1,865 | 1,143 | 855 | 629 |
| 7 | 332 | 286 | 176 | 139 | 174 | 131 | 240 | 1,348 | 1,822 | 1,128 | 842 | 587 |
| 8 | 328 | 276 | 169 | 129 | 178 | 121 | 235 | 1,256 | 1,788 | 1,094 | 837 | 527 |
| 9 | 312 | 268 | 160 | 119 | 182 | 121 | 235 | 1,191 | 1,748 | 1,035 | 818 | 490 |
| 10 | 304 | 276 | 135 | 129 | 182 | 123 | 246 | 1,125 | 1,673 | 951 | 808 | 451 |
| 11 | 304 | 254 | 164 | 135 | 182 | 123 | 249 | 1,040 | 1,587 | 953 | 805 | 415 |
| 12 | 324 | 241 | 164 | 125 | 163 | 95 | 252 | 1,001 | 1,488 | 989 | 803 | 395 |
| 13 | 316 | 258 | 153 | 115 | 137 | 119 | 258 | 978 | 1,417 | 997 | 800 | 361 |
| 14 | 336 | 258 | 169 | 125 | 138 | 79 | 258 | 938 | 1,362 | 1,008 | 796 | 368 |
| 15 | 348 | 261 | 148 | 139 | 140 | 97 | 243 | 921 | 1,320 | 975 | 792 | 344 |
| 16 | 390 | 276 | 182 | 137 | 159 | 119 | 238 | 935 | 1,313 | 969 | 778 | 317 |
| 17 | 412 | 290 | 171 | 137 | 148 | 140 | 246 | 989 | 1,357 | 977 | 767 | 301 |
| 18 | 452 | 294 | 151 | 150 | 131 | 131 | 246 | 1,047 | 1,391 | 972 | 755 | 292 |
| 19 | 521 | 279 | 141 | 150 | 115 | 129 | 166 | 1,142 | 1,414 | 953 | 748 | 289 |
| 20 | 566 | 261 | 156 | 150 | 109 | 113 | 180 | 1,355 | 1,452 | 942 | 748 | 288 |
| 21 | 540 | 248 | 141 | 157 | 103 | 131 | 207 | 1,658 | 1,525 | 949 | 753 | 296 |
| 22 | 521 | 225 | 182 | 159 | 91 | 131 | 312 | 1,998 | 1,616 | 949 | 752 | 288 |
| 23 | 484 | 212 | 145 | 163 | 80 | 125 | 345 | 2,548 | 1,679 | 964 | 753 | 285 |
| 24 | 452 | 215 | 124 | 189 | 69 | 119 | 364 | 2,990 | 1,694 | 965 | 747 | 274 |
| 25 | 441 | 192 | 143 | 182 | 69 | 99 | 394 | 3,223 | 1,684 | 944 | 735 | 269 |
| 26 | 436 | 197 | 151 | 184 | 69 | 109 | 447 | 3,384 | 1,647 | 942 | 739 | 281 |
| 27 | 426 | 190 | 148 | 186 | 60 | 133 | 537 | 3,680 | 1,622 | 941 | 732 | 285 |
| 28 | 408 | 195 | 155 | 179 | 68 | 154 | 616 | 4,179 | 1,640 | 922 | 731 | 290 |
| 29 | 403 | 199 | 155 | 182 | ..... | 184 | 865 | 4,496 | 1,691 | 895 | 725 | 273 |
| 30 | 372 | 192 | 151 | 187 | ..... | 234 | 1,154 | 4,695 | 1,690 | 887 | 713 | 275 |
| 31 | 360 | ..... | 140 | 191 | ..... | 285 | ..... | 4,438 | ..... | 878 | 715 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 207 | 154 | 46 | 196 | 226 | 129 | 347 | 472 | 1,681 | 2,300 | 1,584 | 485 |
| 2 | 200 | 129 | 60 | 218 | 226 | 119 | 104 | 416 | 1,586 | 2,484 | 1,771 | 490 |
| 3 | 187 | 127 | 103 | 201 | 257 | 129 | 107 | 476 | 1,523 | 2,574 | 1,857 | 495 |
| 4 | 175 | 113 | 97 | 201 | 321 | 125 | 135 | 535 | 1,453 | 2,646 | 1,854 | 462 |
| 5 | 168 | 140 | 101 | 206 | 325 | 115 | 148 | 681 | 1,594 | 2,540 | 1,586 | 449 |
| 6 | 156 | 105 | 127 | 189 | 340 | 111 | 170 | 918 | 1,831 | 2,486 | 1,278 | 436 |
| 7 | 147 | 125 | 123 | 177 | 355 | 127 | 170 | 1,188 | 2,083 | 2,330 | 1,095 | 416 |
| 8 | 156 | 113 | 133 | 189 | 359 | 172 | 194 | 1,458 | 2,625 | 2,113 | 995 | 408 |
| 9 | 150 | 111 | 139 | 201 | 367 | 204 | 234 | 1,353 | 3,277 | 1,960 | 959 | 400 |
| 10 | 150 | 131 | 142 | 189 | 325 | 236 | 234 | 1,191 | 3,632 | 1,898 | 964 | 392 |
| 11 | 150 | 131 | 152 | 165 | 283 | 228 | 234 | 1,288 | 3,809 | 1,835 | 969 | 384 |
| 12 | 147 | 131 | 142 | 165 | 277 | 209 | 300 | 1,693 | 3,945 | 1,878 | 1,054 | 380 |
| 13 | 138 | 111 | 119 | 172 | 267 | 209 | 481 | 1,676 | 3,983 | 2,094 | 1,191 | 380 |
| 14 | 130 | 111 | 123 | 212 | 248 | 375 | 886 | 1,660 | 4,091 | 2,006 | 1,241 | 436 |
| 15 | 123 | 131 | 172 | 283 | 236 | 109 | 750 | 1,761 | 4,313 | 1,933 | 1,241 | 650 |
| 16 | 123 | 137 | 194 | 251 | 225 | 152 | 730 | 1,807 | 4,622 | 2,000 | 1,210 | 841 |
| 17 | 125 | 137 | 194 | 209 | 186 | 136 | 840 | 2,090 | 4,711 | 2,127 | 1,054 | 942 |
| 18 | 125 | 137 | 206 | 196 | 194 | 140 | 875 | 2,424 | 4,766 | 2,351 | 936 | 933 |
| 19 | 121 | 135 | 206 | 196 | 191 | 140 | 887 | 2,475 | 4,598 | 2,636 | 834 | 908 |
| 20 | 119 | 152 | 206 | 79 | 133 | 234 | 570 | 2,614 | 4,306 | 2,647 | 772 | 899 |
| 21 | 106 | 152 | 219 | 87 | 165 | 467 | 300 | 2,758 | 4,215 | 2,608 | 706 | 942 |
| 22 | 106 | 222 | 194 | 67 | 165 | 518 | 332 | 2,740 | 4,039 | 2,428 | 651 | 899 |
| 23 | 104 | 300 | 196 | 49 | 150 | 497 | 350 | 2,650 | 3,968 | 2,379 | 641 | 849 |
| 24 | 115 | 462 | 251 | 48 | 157 | 508 | 392 | 2,758 | 3,912 | 2,367 | 615 | 801 |
| 25 | 130 | 513 | 270 | 154 | 140 | 434 | 372 | 2,444 | 3,277 | 2,343 | 601 | 743 |
| 26 | 159 | 355 | 317 | 219 | 150 | 351 | 372 | 2,357 | 2,802 | 2,343 | 571 | 676 |
| 27 | 158 | 209 | 310 | 201 | 123 | 351 | 548 | 2,150 | 2,465 | 2,261 | 567 | 608 |
| 28 | 157 | 60 | 320 | 212 | 133 | 371 | 724 | 1,997 | 2,297 | 2,164 | 585.7 | 568 |
| 29 | 157 | 60 | 267 | 206 | 123 | 379 | 562 | 1,818 | 2,246 | 1,882 | 550.8 | 602 |
| 30 | 157 | 60 | 222 | 231 | ..... | 355 | 520 | 1,750 | 2,229 | 1,753 | 560.2 | 574 |
| 31 | 157 | ..... | 184 | 228 | ..... | 404 | ..... | 1,695 | ..... | 1,563 | 527 | ..... |

NOTE.—For tables of daily discharge of St. Mary canal at St. Mary crossing, see p. 23.

*Combined monthly discharge of St. Mary River near Kimball, Alberta, and St. Mary canal at St. Mary crossing, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19. | | | | |
| October | 566 | 304 | 394 | 24,200 |
| November | 352 | 190 | 259 | 15,400 |
| December | 197 | 124 | 162 | 9,960 |
| January | 191 | 115 | 150 | 9,220 |
| February | 182 | 60 | 135 | 7,500 |
| March | 285 | 59 | 123 | 7,560 |
| April | 1,154 | 166 | 340 | 20,200 |
| May | 4,695 | 921 | 1,978 | 122,000 |
| June | 3,973 | 1,313 | 1,783 | 106,000 |
| July | 1,626 | 878 | 1,037 | 63,800 |
| August | 869 | 713 | 785 | 48,300 |
| September | 719 | 269 | 410 | 24,400 |
| The year | 4,695 | 59 | 633 | 459,000 |
| 1919–20. | | | | |
| October | 207 | 104 | 145 | 8,920 |
| November | 513 | 60 | 165 | 9,820 |
| December | 320 | 46 | 179 | 11,000 |
| January | 283 | 48 | 181 | 11,100 |
| February | 367 | 123 | 229 | 13,200 |
| March | 518 | 111 | 259 | 15,900 |
| April | 887 | 104 | 429 | 25,500 |
| May | 2,758 | 416 | 1,720 | 106,000 |
| June | 4,766 | 1,453 | 3,196 | 190,000 |
| July | 2,647 | 1,563 | 2,224 | 132,000 |
| August | 1,857 | 527 | 1,001 | 59,600 |
| September | 942 | 380 | 615 | 36,600 |
| The year | 4,766 | 46 | 863 | 620,000 |

NOTE.—For tables of monthly discharge of St. Mary canal at St. Mary crossing, see p. 23.

### ST. MARY CANAL AT INTAKE, NEAR BABB, MONT.

LOCATION.—In NW. ¼ sec. 27, T. 36 N., R. 14 W., 600 feet below intake of canal and 2 miles south of Babb, on Blackfeet Indian Reservation, in Glacier County.

RECORDS AVAILABLE.—June 1, 1918, to August 31, 1920.

GAGE.—Gurley printing water-stage recorder in wooden shelter on right bank. Prior to April 17, 1919, a staff gage 300 feet above present gage was read. The two gages were set to read the same but are not at the same datum on account of the slope in canal between the two points.

DISCHARGE MEASUREMENTS.—Made from cable 10 feet above gage. Current is evenly distributed throughout cross section and has a moderate velocity at all stages.

CHANNEL AND CONTROL.—Bed composed of gravel. Repairs to canal may cause slight changes in stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 6.23 feet May 15 (discharge, 550 second-feet).

Maximum stage recorded during year ending September 30, 1920, 7.04 feet August 8 (discharge, 655 second-feet).

1918–1920: Maximum stage recorded, 7.04 feet August 8, 1920 (discharge, 655 second-feet).

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation changed during period June 2 to July 8, 1919, when channel was being repaired; permanent during other periods. Two rating curves used during 1919, the first, applicable April 18 to June 1, is fairly well defined between 130 and 552 second-feet, and the second, applicable July 9 to September 30, is well defined between 20 and 512 second-feet. Rating curve used during 1920 is well defined between 10 and 650 second-feet. Operation of water-stage recorder unsatisfactory during 1919; gage heights were obtained from observer's readings twice daily to hundredths on staff gage 300 feet upstream from recorder. Gage heights during periods June 25 to August 12, and August 25–31, 1920, were obtained from Gurley printing water-stage recorder records; observer's readings once daily to hundredths on staff gage 300 feet upstream from recorder, used for other periods during 1920. Daily discharge, April 18 to June 1, 1919, ascertained by applying mean daily gage height to rating table; June 2 to July 8, 1919, by indirect method for shifting control; June 25 to August 12, 1920, and August 25–31, 1920, by applying mean daily gage height from Gurley printing water-stage recorder to rating table, and during other periods in 1920 by applying observed daily gage height to rating table. Records prior to July 9, 1919, are fair and thereafter during 1919 they are good. Records for 1920 are excellent.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

St. Mary canal diverts water from the west bank of St. Mary River near Babb, Mont., and discharges into the North Fork of Milk River. The water then flows in the natural channel of Milk River through Canada and is finally used for irrigation in the Milk River Valley east of Havre, Mont. Water may be returned to the St. Mary River at St. Mary crossing.

*Discharge measurements of St. Mary canal at intake, near Babb, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Apr. 18 | W. A. Lamb | 2.50 | 136 | Sept. 11 | C. F. Corbett | 3.00 | 144 |
| 30 | C. H. Ellacott [a] | 5.60 | 468 | 20 | B. E. Jones | 2.19 | 88 |
| May 14 | W. A. Lamb | 6.23 | 549 | Oct. 2 | Corbett and Ford [a] | 1.93 | 70 |
| 18 | Corbett [a] and Newhall [a] | 6.16 | 542 | | | | |
| June 18 | C. F. Corbett | 5.92 | 491 | 1920. | | | |
| 18 | W. A. Lamb | 5.94 | 506 | May 28 | W. A. Lamb | 4.88 | 369 |
| July 9 | C. F. Corbett | 5.95 | 495 | June 9 | A. W. P. Lowrie [b] | 5.66 | 457 |
| 10 | B. E. Jones | 5.96 | 493 | 25 | W. A. Lamb | 6.21 | 542 |
| 28 | W. A. Lamb | 5.98 | 497 | July 26 | do | 6.41 | 566 |
| 28 | C. F. Corbett | 5.98 | 507 | Aug. 2 | A. W. P. Lowrie | 6.54 | 574 |
| Aug. 15 | do | 6.04 | 500 | 6 | H. S. Price | 6.75 | 613 |
| 19 | B. E. Jones | 6.02 | 479 | 25 | W. A. Lamb | 3.36 | 185 |
| 22 | W. A. Lamb | 6.04 | 504 | 27 | S. G. Dawson [a] | 2.47 | 105 |
| Sept. 3 | Dawson [a] and Jones | 6.02 | 493 | 27 | W. A. Lamb | 2.46 | 109 |
| 10 | do | 3.82 | 224 | 31 | do | .58 | 12.5 |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Engineer, Water Power Branch, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary canal at intake, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Oct. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | | 1919–20. | | | | | |
| 1 | ..... | 474 | 500 | 491 | 502 | 502 | 1 | 71 | ..... | 427 | 555 | 563 |
| 2 | ..... | 494 | 499 | 493 | 502 | 501 | 2 | 71 | ..... | 424 | 555 | 573 |
| 3 | ..... | 514 | 500 | 493 | 502 | 502 | 3 | 71 | ..... | 424 | 557 | 585 |
| 4 | ..... | 526 | 502 | 491 | 502 | 501 | 4 | 71 | ..... | 453 | 560 | 597 |
| 5 | ..... | 543 | 502 | 491 | 502 | 364 | 5 | 70 | ..... | 457 | 560 | 606 |
| 6 | ..... | 543 | 499 | 493 | 502 | 364 | 6 | 70 | ..... | 461 | 562 | 609 |
| 7 | ..... | 510 | 502 | 493 | 501 | 250 | 7 | 70 | ..... | 466 | 560 | 643 |
| 8 | ..... | 520 | 502 | 493 | 502 | 228 | 8 | 70 | ..... | 450 | 559 | 655 |
| 9 | ..... | 520 | 495 | 491 | 502 | 224 | 9 | 70 | ..... | 457 | 559 | 604 |
| 10 | ..... | 511 | 502 | 491 | 502 | 144 | 10 | 70 | ..... | 466 | 562 | 566 |
| 11 | ..... | 511 | 500 | 494 | 502 | 143 | 11 | 70 | ..... | 464 | 563 | 564 |
| 12 | ..... | 520 | 497 | 492 | 502 | 94 | 12 | 70 | ..... | 464 | 564 | 569 |
| 13 | ..... | 543 | 499 | 492 | 502 | 94 | 13 | 70 | ..... | 464 | 564 | 566 |
| 14 | ..... | 545 | 497 | 494 | 502 | 94 | 14 | 70 | ..... | 470 | 563 | 564 |
| 15 | ..... | 550 | 500 | 495 | 501 | 94 | 15 | 70 | ..... | 483 | 560 | 564 |
| 16 | ..... | 528 | 502 | 498 | 502 | 94 | 16 | 70 | ..... | 487 | 553 | 564 |
| 17 | ..... | 536 | 500 | 497 | 501 | 94 | 17 | 70 | ..... | 496 | 563 | 556 |
| 18 | 139 | 540 | 499 | 499 | 502 | 85 | 18 | 70 | ..... | 505 | 563 | 559 |
| 19 | 139 | 542 | 499 | 498 | 504 | 85 | 19 | 70 | ..... | 528 | 560 | 519 |
| 20 | 139 | 529 | 499 | 499 | 502 | 85 | 20 | 70 | ..... | 528 | 563 | 522 |
| 21 | 139 | 530 | 500 | 499 | 501 | 84 | 21 | 95 | ..... | 528 | 564 | 523 |
| 22 | 276 | 510 | 498 | 499 | 502 | 84 | 22 | 95 | ..... | 527 | 566 | 230 |
| 23 | 300 | 497 | 498 | 499 | 504 | 84 | 23 | 70 | ..... | 528 | 566 | 179 |
| 24 | 312 | 502 | 498 | 499 | 501 | 84 | 24 | ..... | ..... | 527 | 566 | 192 |
| 25 | 360 | 499 | 495 | 498 | 502 | 73 | 25 | ..... | 262 | 532 | 564 | 163 |
| 26 | 271 | 497 | 495 | 499 | 502 | 73 | 26 | ..... | 270 | 536 | 564 | 105 |
| 27 | 378 | 502 | 495 | 498 | 502 | 71 | 27 | ..... | 274 | 545 | 563 | 92 |
| 28 | 410 | 502 | 495 | 491 | 501 | 71 | 28 | ..... | 363 | 543 | 562 | 12.5 |
| 29 | 442 | 499 | 494 | 499 | 501 | 72 | 29 | ..... | 427 | 552 | 553 | 12.5 |
| 30 | 462 | 500 | 493 | 502 | 502 | 71 | 30 | ..... | 431 | 555 | 560 | 12.5 |
| 31 | ..... | 499 | ..... | 502 | 502 | ..... | 31 | ..... | 427 | ..... | 557 | 12.5 |

*Monthly discharge of St. Mary canal at intake, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| April 18–30 | 462 | 139 | 290 | 7,480 |
| May | 550 | 474 | 517 | 31,800 |
| June | 502 | 493 | 499 | 29,700 |
| July | 502 | 491 | 496 | 30,500 |
| August | 504 | 501 | 502 | 30,900 |
| September | 502 | 71 | 177 | 10,500 |
| The period | 550 | 71 | 428 | 141,000 |
| 1919–20. | | | | |
| October 1–23 | 95 | 70 | 72.3 | 3,300 |
| May 25–31 | 431 | 262 | 351 | 4,870 |
| June | 555 | 424 | 492 | 29,300 |
| July | 566 | 553 | 561 | 34,500 |
| August | 655 | 12.5 | 422 | 25,900 |

### ST. MARY CANAL AT ST. MARY CROSSING, NEAR BABB, MONT.

LOCATION.—In NE. ¼ sec. 30, T. 37 N., R. 13 W. Montana meridian, 250 feet east of outlet of siphon by which canal crosses St. Mary River, 10 miles below intake, and 9 miles north of Babb, in Glacier County.

RECORDS AVAILABLE.—July 6, 1918, to August 31, 1920.

GAGE.—Stevens continuous water-stage recorder in wooden shelter on right bank; installed April 22, 1919. During 1918 a Stevens water-stage recorder on concrete entrance to flume, 313 feet downstream from present recorder, was used.

DISCHARGE MEASUREMENTS.—Made from cable 188 feet below gage.

CHANNEL AND CONTROL.—Control is at the head of the steel flume 313 feet below gage and is practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 6.61 feet at 4 p. m. May 15 (discharge, 421 second-feet).

Maximum stage recorded during year ending September 30, 1920, 4.69 feet at 11 p. m. August 8 (discharge, 487 second-feet).

1918–1920: Maximum discharge recorded, 487 second-feet at 11 p. m. August 8, 1920.

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve used during 1919, well defined between 45 and 410 second-feet. Rating curve used during 1920, well defined between 10 and 500 second-feet. Mean daily gage heights obtained from water-stage recorder graph by inspection except for May 25 and August 28 when hourly-discharge method was used. Daily discharge ascertained by applying mean daily gage height to rating table except for period indicated in footnote to tables of daily discharge and except for days for which hourly-discharge method was used. Records excellent.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

*Discharge measurements of St. Mary canal at St. Mary crossing, near Babb, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| May 1 | C. H. Ellacott [a] | 5.95 | 357 | June 5 | S. G. Dawson [b] | 4.01 | 357 |
| 13 | W. A. Lamb | 6.40 | 402 | 5 | do | 2.88 | 182 |
| 19 | Corbett [a] and Newhall [a] | 6.46 | 417 | 10 | A. W. P. Lowrie [c] | 4.03 | 355 |
| June 2 | Burley [a] and Dawson [a] | 6.28 | 389 | 17 | S. G. Dawson | 4.19 | 376 |
| 14 | Jones and Dawson | 6.28 | 376 | 22 | W. A. Lamb | 4.31 | 401 |
| 18 | C. F. Corbett | 6.32 | 401 | 22 | S. G. Dawson | 4.31 | 396 |
| July 9 | do | 6.32 | 404 | 22 | A. W. P. Lowrie | 4.31 | 406 |
| 27 | do | 6.28 | 390 | July 8 | S. G. Dawson | 4.39 | 429 |
| Aug. 15 | do | 6.32 | 377 | 14 | do | 4.45 | 435 |
| 29 | S. G. Dawson | 6.27 | 378 | 28 | W. A. Lamb | 4.47 | 441 |
| Sept. 5 | Dawson and Jones | 5.55 | 315 | Aug. 2 | A. W. P. Lowrie | 4.48 | 428 |
| 10 | do | 4.21 | 192 | 3 | do | 4.51 | 439 |
| 11 | C. F. Corbett | 3.36 | 122 | 7 | H. S. Price | 4.68 | 490 |
| Oct. 2 | Corbett and Ford [a] | 2.23 | 55 | 20 | S. G. Dawson | 4.29 | 407 |
| 1920. | | | | 25 | W. A. Lamb | 2.51 | 151 |
| | | | | 27 | S. G. Dawson | 1.96 | 96 |
| May 28 | W. A. Lamb | 3.54 | 282 | 27 | W. A. Lamb | 1.96 | 97 |
| 29 | do | 3.84 | 333 | 28 | do | .86 | 12.4 |

[a] Engineer, Irrigation Branch, Department of the Interior, Canada.
[b] Engineer, Reclamation Service, Department of the Interior, Canada.
[c] Engineer, Water Power Branch, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary canal at St. Mary crossing, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Oct. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | | 1919–20. | | | | | |
| 1 | ..... | 355 | 389 | 380 | 388 | 389 | 1 | 55 | ..... | 337 | 373 | 440 |
| 2 | ..... | 368 | 388 | 382 | 388 | 387 | 2 | 54 | ..... | 316 | 366 | 436 |
| 3 | ..... | 372 | 388 | 383 | 389 | 386 | 3 | 54 | ..... | 332 | 374 | 452 |
| 4 | ..... | 388 | 389 | 382 | 389 | 385 | 4 | 54 | ..... | 345 | 420 | 459 |
| 5 | ..... | 394 | 391 | 384 | 386 | 322 | 5 | 53 | ..... | 297 | 422 | 461 |
| 6 | ..... | 398 | 391 | 391 | 385 | 303 | 6 | 52 | ..... | 345 | 420 | 461 |
| 7 | ..... | 386 | 386 | 391 | 385 | 298 | 7 | 52 | ..... | 322 | 391 | 475 |
| 8 | ..... | 385 | 390 | 393 | 385 | 294 | 8 | 52 | ..... | 359 | 422 | 480 |
| 9 | ..... | 388 | 388 | 390 | 384 | 198 | 9 | 54 | ..... | 352 | 430 | 469 |
| 10 | ..... | 388 | 392 | 392 | 387 | 191 | 10 | 54 | ..... | 308 | 430 | 434 |
| 11 | ..... | 388 | 392 | 394 | 388 | 126 | 11 | 52 | ..... | 352 | 430 | 434 |
| 12 | ..... | 388 | 392 | 395 | 390 | 123 | 12 | 52 | ..... | 355 | 432 | 434 |
| 13 | ..... | 397 | 392 | 390 | 392 | 98 | 13 | 51 | ..... | 355 | 436 | 434 |
| 14 | ..... | 407 | 392 | 389 | 392 | 76 | 14 | 50 | ..... | 311 | 434 | 432 |
| 15 | ..... | 411 | 389 | 388 | 392 | 78 | 15 | 50 | ..... | 324 | 434 | 432 |
| 16 | ..... | 393 | 389 | 388 | 391 | 77 | 16 | 49 | ..... | 367 | 428 | 432 |
| 17 | ..... | 402 | 387 | 390 | 392 | 76 | 17 | 48 | ..... | 380 | 436 | 434 |
| 18 | ..... | 402 | 390 | 391 | 389 | 78 | 18 | 49 | ..... | 321 | 436 | 436 |
| 19 | ..... | 405 | 389 | 389 | 390 | 72 | 19 | 49 | ..... | 380 | 436 | 406 |
| 20 | ..... | 393 | 388 | 389 | 390 | 68 | 20 | 51 | ..... | 402 | 434 | 404 |
| 21 | ..... | 395 | 388 | 390 | 391 | 69 | 21 | 54 | ..... | 402 | 436 | 402 |
| 22 | 139 | 391 | 387 | 390 | 390 | 68 | 22 | 79 | ..... | 406 | 440 | 231 |
| 23 | 207 | 372 | 390 | 389 | 391 | 68 | 23 | 74 | ..... | 335 | 440 | 174 |
| 24 | 230 | 378 | 387 | 390 | 389 | 67 | 24 | 30 | ..... | 387 | 440 | 153 |
| 25 | 247 | 373 | 386 | 391 | 389 | 65 | 25 | ..... | 44 | 410 | 440 | 152 |
| 26 | 222 | 376 | 384 | 389 | 389 | 59 | 26 | ..... | 209 | 350 | 440 | 99 |
| 27 | 248 | 380 | 384 | 388 | 390 | 58 | 27 | ..... | 220 | 412 | 442 | 91 |
| 28 | 274 | 381 | 386 | 386 | 389 | 57 | 28 | ..... | 282 | 418 | 440 | 17.7 |
| 29 | 301 | 386 | 384 | 385 | 387 | 56 | 29 | ..... | 303 | 391 | 436 | 4.8 |
| 30 | 328 | 389 | 383 | 387 | 387 | 58 | 30 | ..... | 330 | 398 | 438 | 3.2 |
| 31 | ..... | 386 | ..... | 388 | 389 | ..... | 31 | ..... | 333 | ..... | 438 | 2.0 |

NOTE.—Operation of water-stage recorder unsatisfactory during period April 27–30, 1919; discharge interpolated.

*Monthly discharge of St. Mary canal at St. Mary crossing, near Babb, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| April 22–30 | 328 | 139 | 244 | 4,360 |
| May | 411 | 355 | 388 | 23,900 |
| June | 392 | 383 | 388 | 23,100 |
| July | 395 | 380 | 389 | 23,900 |
| August | 392 | 384 | 389 | 23,900 |
| September | 389 | 56 | 155 | 9,220 |
| The period | 411 | 56 | 337 | 108,000 |
| 1919–20. | | | | |
| October 1–24 | 79 | 30 | 53.0 | 2,520 |
| May 25–31 | 333 | 44 | 246 | 3,420 |
| June | 418 | 297 | 359 | 21,400 |
| July | 442 | 366 | 426 | 26,200 |
| August | 480 | 2.0 | 328 | 20,200 |

### ST. MARY CANAL AT HUDSON BAY DIVIDE, NEAR BROWNING, MONT.

LOCATION.—In NE. ¼ sec. 5, T. 37 N., R. 11 W., on Hudson Bay Divide, 12 feet above first concrete drop in canal, on Blackfeet Indian Reservation, a quarter of a mile south of international boundary, and 30 miles north of Browning, in Glacier County.

RECORDS AVAILABLE.—July 3, 1917, to August 31, 1920.

GAGE.—Stevens water-stage recorder in wooden shelter on left bank used since June 29, 1920. The recorder was on right bank 40 feet above present site during 1919 and from May 25 to June 28, 1920. Prior to 1919 a staff gage at different datum located at Douglas bridge 1 mile above was used.

CHANNEL AND CONTROL.—Canal has uniform section. At high stages the slope of water surface changes slightly with the change in stage. Control is a V-shaped notch in the concrete drop 12 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 6.20 feet at 7 p. m. May 15 (discharge, 416 second-feet).

Maximum stage recorded during year ending September 30, 1920, 5.92 feet at 6 p. m. August 9 (discharge, 472 second-feet).

1917–1920: Maximum discharge recorded, 472 second-feet at 6 p. m. August 9, 1920.

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice October 24–26, 1919. Rating curve used during 1919 is fairly well defined for all stages. Two well-defined rating curves used during 1920, applicable respectively, May 26 to June 28 and June 29 to August 31. Mean daily gage height obtained by inspection from water-stage recorder graph. Daily discharge ascertained by applying mean daily gage height to rating table except for periods May 26–29, and September 22, 23, and 27–29, 1919, for which it was ascertained by hourly-discharge method and except for period October 24–26, 1919, when stage-discharge relation was affected by ice for which it was estimated. Records excellent.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

*Discharge measurements of St. Mary canal at Hudson Bay divide, near Browning, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Apr. 25 | C. H. Ellacott[a] | 5.02 | 224 | May 29 | W. A. Lamb | 5.25 | 283 |
| May 13 | W. A. Lamb | 6.10 | 410 | June 7 | S. G. Dawson | 5.64 | 341 |
| June 2 | C. F. Corbett[a] | 6.02 | 389 | 9 | A. W. P. Lowrie[c] | 5.66 | 357 |
| 17 | ....do | 6.04 | 374 | 18 | S. G. Dawson | 5.88 | 381 |
| 17 | Lamb and Jones | 6.04 | 391 | 22 | Lamb and Whyte[c] | 6.03 | 418 |
| July 8 | C. F. Corbett | 6.02 | 382 | 22 | S. G. Dawson | 6.03 | 414 |
| 25 | W. A. Lamb | 6.03 | 370 | 22 | A. W. P. Lowrie | 6.03 | 408 |
| 26 | C. F. Corbett | 5.99 | 374 | July 14 | S. G. Dawson | 5.75 | 443 |
| Aug. 14 | ....do | 6.00 | 380 | 17 | A. W. P. Lowrie | 5.72 | 432 |
| 29 | Dawson[a] and Jones | 5.99 | 367 | 28 | W. A. Lamb | 5.73 | 440 |
| 30 | ....do | 6.00 | 381 | Aug. 4 | A. W. P. Lowrie | 5.77 | 448 |
| Sept. 10 | C. F. Corbett | 4.64 | 185 | 9 | W. A. Lamb | 5.90 | 468 |
| 13 | S. G. Dawson | 3.98 | 112 | 26 | S. G. Dawson | 3.75 | 140 |
| 22 | ....do | 3.37 | 69 | 27 | A. W. P. Lowrie | 3.14 | 92 |
| Oct. 1 | Corbett and Ford[a] | 2.97 | 49.0 | 29 | ....do | 1.64 | 17.4 |
| 25 | O. H. Hoover[a] | [b]2.61 | 15.8 | Sept. 1 | W. A. Lamb | .93 | 4.5 |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation affected by ice.
[c] Engineer, Water Power Branch, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Oct. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | | 1919-20. | | | | | |
| 1 | ..... | 336 | 379 | 377 | 384 | 375 | 1 | 50 | ..... | 335 | 410 | 435 |
| 2 | ..... | 346 | 383 | 377 | 384 | 374 | 2 | 52 | ..... | 332 | 392 | 437 |
| 3 | ..... | 363 | 379 | 377 | 386 | 372 | 3 | 52 | ..... | 323 | 381 | 445 |
| 4 | ..... | 368 | 379 | 379 | 386 | 374 | 4 | 51 | ..... | 333 | 392 | 447 |
| 5 | ..... | 368 | 381 | 383 | 384 | 361 | 5 | 50 | ..... | 347 | 421 | 452 |
| 6 | ..... | 375 | 383 | 386 | 383 | 300 | 6 | 48 | ..... | 313 | 435 | 454 |
| 7 | ..... | 383 | 379 | 383 | 383 | 284 | 7 | 49 | ..... | 345 | 435 | 459 |
| 8 | ..... | 381 | 377 | 383 | 384 | 280 | 8 | 46 | ..... | 340 | 415 | 464 |
| 9 | ..... | 388 | 381 | 383 | 384 | 248 | 9 | 41 | ..... | 350 | 426 | 469 |
| 10 | ..... | 393 | 383 | 383 | 384 | 180 | 10 | 59 | ..... | 350 | 438 | 457 |
| 11 | ..... | 388 | 381 | 383 | 384 | 167 | 11 | 57 | ..... | 325 | 440 | 440 |
| 12 | ..... | 393 | 377 | 384 | 386 | 133 | 12 | 59 | ..... | 352 | 454 | 438 |
| 13 | ..... | 395 | 381 | 379 | 384 | 116 | 13 | 51 | ..... | 359 | 445 | 438 |
| 14 | ..... | 397 | 384 | 377 | 381 | 98 | 14 | 50 | ..... | 362 | 442 | 435 |
| 15 | ..... | 408 | 381 | 379 | 381 | 80 | 15 | 50 | ..... | 335 | 440 | 435 |
| 16 | ..... | 399 | 383 | 379 | 381 | 79 | 16 | 50 | ..... | 345 | 438 | 437 |
| 17 | ..... | 392 | 384 | 379 | 383 | 79 | 17 | 48 | ..... | 386 | 438 | 437 |
| 18 | ..... | 386 | 384 | 374 | 384 | 81 | 18 | 48 | ..... | 384 | 438 | 430 |
| 19 | ..... | 390 | 384 | 377 | 381 | 78 | 19 | 48 | ..... | 342 | 438 | 423 |
| 20 | ..... | 386 | 384 | 379 | 381 | 66 | 20 | 50 | ..... | 381 | 438 | 411 |
| 21 | ..... | 384 | 386 | 381 | 384 | 68 | 21 | 50 | ..... | 401 | 438 | 411 |
| 22 | ..... | 386 | 388 | 379 | 377 | 70 | 22 | 51 | ..... | 411 | 447 | 376 |
| 23 | 155 | 375 | 388 | 381 | 377 | 66 | 23 | 39 | ..... | 403 | 438 | 235 |
| 24 | 199 | 368 | 383 | 383 | 381 | 65 | 24 | 64 | ..... | 366 | 438 | 162 |
| 25 | 222 | 370 | 383 | 383 | 379 | 66 | 25 | 16 | ..... | 384 | 440 | 148 |
| 26 | 228 | 370 | 383 | 379 | 379 | 60 | 26 | 2 | 72 | 403 | 438 | 135 |
| 27 | 203 | 372 | 383 | 383 | 381 | 58 | 27 | ..... | 219 | 377 | 438 | 95 |
| 28 | 262 | 365 | 384 | 379 | 381 | 58 | 28 | ..... | 256 | 410 | 438 | 79 |
| 29 | 291 | 381 | 383 | 377 | 379 | 56 | 29 | ..... | 285 | 416 | 438 | 27 |
| 30 | 310 | 383 | 383 | 379 | 379 | 52 | 30 | ..... | 313 | 408 | 438 | 7.3 |
| 31 | ..... | 368 | ..... | 381 | 383 | ..... | 31 | ..... | 328 | ..... | 437 | 5.1 |

*Monthly discharge of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| April 23-30 | 310 | 155 | 234 | 3,710 |
| May | 408 | 336 | 379 | 23,300 |
| June | 388 | 377 | 382 | 22,700 |
| July | 386 | 374 | 380 | 23,400 |
| August | 386 | 377 | 382 | 23,500 |
| September | 375 | 52 | 158 | 9,400 |
| The period | 408 | 52 | 332 | 106,000 |
| 1919-20. | | | | |
| October 1-26 | 64 | 2 | 47.4 | 2,440 |
| May 26-31 | 328 | 72 | 246 | 2,930 |
| June | 416 | 313 | 364 | 21,700 |
| July | 454 | 381 | 432 | 26,600 |
| August | 469 | 5.1 | 339 | 20,800 |

### SWIFTCURRENT CREEK AT MANY GLACIER, MONT.

LOCATION.—In sec. 12, T. 35 N., R. 16 W., at outlet of McDermott Lake at Many Glacier, in Glacier National Park, 14 miles southwest of Babb, in Glacier County.

DRAINAGE AREA.—31.4 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 6, 1912, to September 30, 1920.

GAGE.—Stevens continuous water-stage recorder installed June 15, 1918, in shelter built by park officials and Great Northern Railway, and referred to two staff gages, one inside well and one outside. Prior to May 23, 1916, a staff gage on the left bank opposite the present gage was read. May 23, 1916, to June 15, 1918, a vertical staff at same location as present gage was read. Gage read by A. Pullman and C. N. McGillis.

DISCHARGE MEASUREMENTS.—Made by wading above crest of falls or 1,000 feet below at low stage. Since June 26, 1920, high-water measurements made from cable 1,000 feet below gage; prior to that date from highway bridge above power house. Section at bridge is poor.

CHANNEL AND CONTROL.—Control is limestone outcrop at outlet of lake; shifts slightly. Just below control is a fall and a cataract.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.00 feet at 1 a. m. May 28 (discharge, 1,100 second-feet); minimum stage, 1.40 feet January 14–16 (discharge, 23 second-feet).

Maximum stage recorded during year ending September 30, 1920, 3.86 feet at noon June 16 (discharge, 1,020 second-feet); minimum stage, 1.35 feet at 8.30 a. m. March 8 (discharge, 18.5 second-feet).

1912–1920: Maximum stage recorded, 4.75 feet June 17, 1916 (discharge, 1,550 second-feet); minimum discharge, 8.7 second-feet April 1, 1913, by current-meter measurement (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation occasionally affected by ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during 1919 and was affected by ice for a short period; permanent during 1920. Two rating curves used during 1919, one, applicable October 1 to May 28, is fairly well defined, and the other, applicable May 29 to September 30, is well defined. Rating curve used during 1920 is well defined between 60 second-feet and 400 second-feet and fairly well defined above 400 second-feet. Gage heights obtained from Stevens water-stage recorder graph by straight-edge method October 1-9, October 20 to November 17, 1918, April 16 to October 14, 1919, May 26 to June 20, June 25 to August 16, and August 19 to September 20, 1920. Observer's readings once daily to hundredths used November 18, 1918, to April 15, 1919, and mean of two readings daily to hundredths used October 15, 1919, to March 31, 1920. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Records fair October 1, 1918, to May 28, 1919; thereafter good.

*Discharge measurements of Swiftcurrent Creek at Many Glacier, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| June 12 | B. E. Jones | 2.50 | 246 | Sept. 1 | S. G. Dawson | 1.90 | 78 |
| 18 | W. A. Lamb | 2.70 | 355 | 21 | B. E. Jones | 1.78 | 60 |
| July 9 | Jones and Dawson | 2.26 | 170 | | | | |
| 26 | W. A. Lamb | 2.10 | 130 | 1920. | | | |
| 28 | S. G. Dawson[a] | 2.05 | 111 | June 26 | W. A. Lamb | 2.72 | 365 |
| Aug. 15 | Jones and Haydon[a] | 1.95 | 92 | July 27 | ....do | 2.38 | 220 |
| 27 | Dawson and Jones | 1.94 | 84 | | | | |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.

*Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 73 | 53 | 34 | 30 | 41 | 26 | 43 | 394 | 311 | 215 | 142 | 79 |
| 2 | 75 | 52 | 32 | 30 | 41 | 24 | 46 | 272 | 259 | 181 | 154 | 75 |
| 3 | 76 | 51 | 32 | 30 | 41 | 24 | 46 | 199 | 280 | 181 | 157 | 71 |
| 4 | 78 | 51 | 32 | 30 | 39 | 24 | 48 | 164 | 367 | 192 | 161 | 67 |
| 5 | 78 | 52 | 32 | 30 | 36 | 28 | 68 | 152 | 469 | 218 | 131 | 63 |
| 6 | 85 | 51 | 32 | 28 | 36 | 32 | 65 | 140 | 474 | 251 | 112 | 59 |
| 7 | 84 | 50 | 34 | 28 | 36 | 39 | 68 | 129 | 437 | 207 | 112 | 55 |
| 8 | 76 | 48 | 32 | 28 | 36 | 41 | 65 | 124 | 401 | 171 | 112 | 53 |
| 9 | 71 | 47 | 34 | 28 | 43 | 41 | 62 | 124 | 365 | 168 | 118 | 49 |
| 10 | 65 | 47 | 34 | 28 | 41 | 39 | 62 | 124 | 329 | 178 | 112 | 49 |
| 11 | 100 | 50 | 32 | 27 | 39 | 32 | 62 | 140 | 289 | 199 | 108 | 49 |
| 12 | 140 | 47 | 30 | 25 | 39 | 30 | 62 | 149 | 271 | 234 | 105 | 63 |
| 13 | 120 | 44 | 30 | 25 | 39 | 28 | 68 | 129 | 255 | 211 | 100 | 61 |
| 14 | 115 | 53 | 32 | 23 | 36 | 27 | 65 | 119 | 285 | 192 | 96 | 59 |
| 15 | 110 | 68 | 32 | 23 | 36 | 27 | 59 | 149 | 276 | 178 | 90 | 59 |
| 16 | 115 | 55 | 32 | 23 | 32 | 28 | 53 | 188 | 343 | 196 | 92 | 56 |
| 17 | 110 | 48 | 32 | 27 | 32 | 28 | 58 | 263 | 372 | 215 | 94 | 53 |
| 18 | 100 | 46 | 32 | 43 | 32 | 30 | 75 | 293 | 362 | 178 | 100 | 53 |
| 19 | 98 | 43 | 32 | 51 | 32 | 30 | 91 | 375 | 372 | 145 | 105 | 59 |
| 20 | 95 | 43 | 32 | 62 | 32 | 32 | 107 | 612 | 390 | 122 | 112 | 67 |
| 21 | 93 | 41 | 34 | 56 | 34 | 34 | 109 | 712 | 408 | 122 | 112 | 64 |
| 22 | 89 | 41 | 32 | 56 | 34 | 34 | 107 | 778 | 427 | 128 | 108 | 54 |
| 23 | 85 | 41 | 32 | 52 | 32 | 36 | 109 | 998 | 437 | 137 | 96 | 52 |
| 24 | 82 | 39 | 30 | 52 | 32 | 39 | 129 | 783 | 396 | 131 | 90 | 52 |
| 25 | 78 | 39 | 30 | 52 | 32 | 39 | 149 | 673 | 334 | 148 | 85 | 53 |
| 26 | 68 | 36 | 30 | 71 | 32 | 39 | 207 | 884 | 302 | 137 | 87 | 57 |
| 27 | 62 | 36 | 30 | 65 | 30 | 41 | 284 | 1,010 | 377 | 120 | 90 | 57 |
| 28 | 65 | 34 | 32 | 56 | 28 | 41 | 408 | 1,010 | 298 | 112 | 90 | 54 |
| 29 | 70 | 34 | 30 | 53 | ..... | 36 | 536 | 968 | 276 | 115 | 83 | 47 |
| 30 | 65 | 34 | 28 | 48 | ..... | 36 | 478 | 778 | 242 | 120 | 83 | 44 |
| 31 | 59 | ..... | 28 | 43 | ..... | 34 | ..... | 480 | ..... | 122 | 83 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 41 | 33 | 43 | 59 | 50 | 24 | ..... | ..... | 171 | 696 | 271 | 77 |
| 2 | 40 | 35 | 39 | 56 | 48 | 22 | ..... | ..... | 161 | 761 | 251 | 81 |
| 3 | 39 | 34 | 34 | 49 | 47 | 24 | ..... | ..... | 178 | 714 | 230 | 94 |
| 4 | 38 | 34 | 32 | 52 | 47 | 22 | ..... | ..... | 263 | 632 | 215 | 171 |
| 5 | 37 | 32 | 35 | 48 | 47 | 21 | ..... | ..... | 366 | 552 | 199 | 442 |
| 6 | 36 | 29 | 37 | 44 | 48 | 21 | ..... | ..... | 530 | 416 | 188 | 396 |
| 7 | 36 | 30 | 35 | 37 | 49 | 19 | ..... | ..... | 638 | 399 | 181 | 243 |
| 8 | 38 | 30 | 32 | 34 | 43 | 19 | ..... | ..... | 843 | 320 | 174 | 259 |
| 9 | 42 | 30 | 30 | 30 | 35 | 22 | ..... | ..... | 706 | 282 | 178 | 230 |
| 10 | 41 | 28 | 29 | 30 | 34 | 21 | ..... | ..... | 592 | 422 | 171 | 234 |
| 11 | 40 | 27 | 27 | 30 | 34 | 23 | ..... | ..... | 498 | 442 | 164 | 218 |
| 12 | 40 | 27 | 25 | 33 | 34 | 21 | ..... | ..... | 632 | 480 | 168 | 185 |
| 13 | 40 | 25 | 25 | 34 | 37 | 23 | ..... | ..... | 580 | 496 | 164 | 171 |
| 14 | 39 | 27 | 25 | 32 | 37 | 25 | ..... | ..... | 714 | 427 | 181 | 157 |
| 15 | 32 | 31 | 27 | 34 | 37 | 28 | ..... | ..... | 696 | 466 | 161 | 134 |
| 16 | 34 | 36 | 28 | 35 | 31 | 28 | ..... | ..... | 968 | 448 | 171 | 118 |
| 17 | 36 | 44 | 31 | 38 | 28 | 32 | ..... | ..... | 902 | 469 | 150 | 110 |
| 18 | 35 | 56 | 35 | 39 | 30 | 34 | ..... | ..... | 867 | 432 | 129 | 100 |
| 19 | 38 | 59 | 45 | 42 | 32 | 35 | ..... | ..... | 778 | 372 | 106 | 96 |
| 20 | 36 | 59 | 56 | 45 | 32 | 35 | ..... | ..... | 661 | 362 | 102 | 100 |
| 21 | 36 | 58 | 61 | 45 | 30 | 35 | ..... | ..... | 708 | 372 | 98 | ..... |
| 22 | 37 | 56 | 64 | 47 | 27 | 38 | ..... | ..... | 755 | 382 | 102 | ..... |
| 23 | 35 | 57 | 69 | 47 | 28 | 39 | ..... | ..... | 594 | 325 | 108 | ..... |
| 24 | 33 | 59 | 65 | 49 | 30 | 41 | ..... | ..... | 432 | 271 | 108 | ..... |
| 25 | 32 | 57 | 62 | 48 | 30 | 43 | ..... | ..... | 411 | 246 | 112 | ..... |
| 26 | 30 | 57 | 59 | 49 | 29 | 42 | ..... | 218 | 367 | 230 | 118 | ..... |
| 27 | 30 | 56 | 64 | 47 | 27 | 37 | ..... | 215 | 377 | 218 | 115 | ..... |
| 28 | 30 | 54 | 62 | 49 | 24 | 34 | ..... | 207 | 406 | 218 | 110 | ..... |
| 29 | 29 | 50 | 59 | 47 | 25 | 31 | ..... | 211 | 496 | 226 | 94 | ..... |
| 30 | 29 | 46 | 57 | 49 | ..... | 29 | ..... | 209 | 569 | 302 | 87 | ..... |
| 31 | 30 | ..... | 59 | 49 | ..... | 27 | ..... | 181 | ..... | 302 | 83 | ..... |

NOTE.—Discharge estimated on account of lack of gage readings, Oct. 10–19, 1918, by comparison with flow of Canyon Creek near Many Glacier, June 21–24, 1920, by comparison with flow of St. Mary River and Two Medicine River. Discharge interpolated on account of lack of gage readings June 8, 9, 20, 21, Sept. 2–8, Nov. 5, 1919, and Aug. 17–18, 1920. Mean discharge estimated 90 second-feet Sept. 21–30, 1920, on account of lack of gage readings. Discharge estimated because of ice Feb. 28 to Mar. 6, 1919. No record obtained Apr. 1 to Mar. 25, 1920.

*Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 31.4 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | Inches. | Acre-feet. |
| 1918-19. | | | | | | |
| October | 140 | 59 | 86.5 | 2.76 | 3.18 | 5,320 |
| November | 68 | 34 | 45.8 | 1.46 | 1.63 | 2,730 |
| December | 34 | 28 | 31.6 | 1.01 | 1.16 | 1,940 |
| January | 82 | 23 | 42.4 | 1.35 | 1.56 | 2,610 |
| February | 41 | 28 | 35.5 | 1.13 | 1.18 | 1,970 |
| March | 41 | 24 | 32.9 | 1.05 | 1.21 | 2,020 |
| April | 536 | 43 | 126 | 4.01 | 4.47 | 7,500 |
| May | 1,010 | 119 | 429 | 13.7 | 15.79 | 26,400 |
| June | 474 | 242 | 347 | 11.1 | 12.38 | 20,600 |
| July | 251 | 112 | 169 | 5.38 | 6.20 | 10,400 |
| August | 161 | 83 | 107 | 3.41 | 3.93 | 6,580 |
| September | 79 | 44 | 57.8 | 1.84 | 2.05 | 3,440 |
| The year | 1,010 | 23 | 126 | 4.01 | 54.74 | 91,500 |
| 1919-20. | | | | | | |
| October | 42 | 29 | 35.8 | 1.14 | 1.31 | 2,200 |
| November | 59 | 25 | 41.9 | 1.33 | 1.48 | 2,490 |
| December | 69 | 25 | 43.6 | 1.39 | 1.60 | 2,680 |
| January | 59 | 30 | 42.8 | 1.36 | 1.57 | 2,630 |
| February | 50 | 24 | 35.5 | 1.13 | 1.22 | 2,040 |
| March | 43 | 19 | 28.9 | .920 | 1.06 | 1,780 |
| May 26-31 | 218 | 181 | 206 | 6.56 | 1.46 | 2,450 |
| June | 968 | 161 | 577 | 18.4 | 20.53 | 34,300 |
| July | 761 | 218 | 408 | 13.0 | 14.99 | 25,100 |
| August | 271 | 83 | 152 | 4.84 | 5.58 | 9,350 |
| September | 442 | 77 | 154 | 4.90 | 5.47 | 9,160 |

### SWIFTCURRENT CREEK AT SHERBURNE, MONT.

LOCATION.—In sec. 35, T. 36 N., R. 15 W., 800 feet below spillway of Sherburne Lake dam, in Glacier County.

DRAINAGE AREA.—64 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 1, 1912, to September 30, 1920.

GAGE.—Staff gage on left bank about 800 feet below the spillway of Sherburne Lake dam, installed August 10, 1920. From July 1, 1912, to November 9, 1914, a vertical staff gage was maintained on the left bank near outlet of lake and at a different datum from present gage. From November 10, 1914, to August 9, 1920, a staff gage on left bank about 300 feet below the spillway of Sherburne Lake dam was read. Observed by R. R. McComb and others.

DISCHARGE MEASUREMENTS.—Made from cable 450 feet above gage or by wading.

CHANNEL AND CONTROL.—An outcropping limestone ledge, somewhat broken and irregular, forms the control; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 5.90 feet May 29 and 30 (discharge, 950 second-feet); minimum discharge, practically no flow, occurred when gates in dam were closed.

Maximum stage recorded during year ending September 30, 1920, 7.45 feet August 3 (discharge, 1,490 second-feet); minimum discharge, practically no flow, occurred when gates in dam were closed.

1912–1920: Maximum stage recorded, 7.85 feet June 17, 1916 (discharge, 2,280 second-feet); minimum discharge, practically no flow occurs when gates in dam are closed.

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—Flow regulated by gate operations. A record of gate operations has been obtained except during the period June 26 to September 30, 1919, and flow for days during that period when there were sudden changes in gate openings may be considerably in error.

ACCURACY.—Stage-discharge relation changed October 17, 1918, and a landslide August 10, 1920, necessitated moving the gage 500 feet downstream; affected by ice for a short period during winter of 1918–19. Four rating curves used; the first, applicable October 1–17, 1918, is well defined between 60 and 1,200 second-feet; the second, applicable October 18, 1918, to September 30, 1919, is fairly well defined throughout; the third, applicable October 1, 1919, to May 6, 1920, and August 5–9, 1920, is fairly well defined between 30 and 550 second-feet; and the fourth, applicable August 10 to September 30, 1920, is well defined between 90 and 300 second-feet. Shifting-control method used May 7 to June 28 and July 15 to August 4, 1920. Gage read twice daily to hundredths in 1919 except during high water, when it was read to tenths, and once daily to half-tenths or quarter-tenths during 1920. Daily discharge ascertained by applying daily gage height to rating table except for periods for which shifting-control method was used and other periods indicated in footnote to tables of daily discharge. Records good during 1919 except for periods of regulated low flow, for which they are fair. Records during 1920 prior to August 10, fair; subsequent records good.

*Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Apr. 16 | W. A. Lamb | 2.40 | 74 | Sept. 20 | B. E. Jones | 2.31 | 58 |
| May 15 | do | 3.60 | 223 | | | | |
| June 12 | B. E. Jones | .71 | [c].4 | 1920. | | | |
| July 9 | do | 3.13 | 162 | May 28 | W. A. Lamb | 4.55 | 420 |
| 12 | do | 3.67 | 261 | June 27 | do | 2.78 | 88 |
| 26 | W. A. Lamb | 4.38 | 447 | July 26 | do | 7.35 | 1,090 |
| 28 | Dawson[a] and Jones | 4.32 | 410 | Aug. 10 | do | [b]2.95 | 252 |
| Aug. 15 | Haydon[a] and Jones | 4.39 | 427 | 19 | S. G. Dawson | 2.43 | 150 |
| 27 | Dawson and Jones | 4.40 | 432 | 31 | W. A. Lamb | 2.08 | 109 |
| Sept. 10 | do | 2.95 | 145 | | | | |

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] New gage installed 500 feet downstream from old gage; old gage read 3.60 feet.
[c] Estimated.

*Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 60 | 41 | 47 | 36 | 65 | 5 | 34 | 520 | 550 | 326 | 388 | 423 |
| 2 | 61 | 41 | 45 | 30 | 60 | 4 | 112 | 506 | 144 | 211 | 388 | 433 |
| 3 | 61 | 42 | 45 | 25 | 51 | 0 | 118 | 491 | 0 | 152 | 385 | 423 |
| 4 | 62 | 42 | 45 | 24 | 43 | 0 | 118 | 436 | 0 | 152 | 385 | 350 |
| 5 | 62 | 42 | 45 | 16 | 36 | 0 | 93 | 361 | 0 | 260 | 385 | 230 |
| 6 | 64 | 43 | 45 | 16 | 36 | 4 | 93 | 338 | 0 | 260 | 390 | 193 |
| 7 | 65 | 43 | 45 | 16 | 15 | 9 | 93 | 338 | 0 | 267 | 388 | 176 |
| 8 | 66 | 43 | 47 | 14 | 0 | 10 | 93 | 271 | 0 | 267 | 385 | 165 |
| 9 | 66 | 42 | 47 | 12 | 0 | 10 | 93 | 271 | 0 | 163 | 385 | 160 |
| 10 | 67 | 40 | 47 | 12 | 0 | 10 | 93 | 230 | 0 | 165 | 388 | 138 |
| 11 | 68 | 40 | 47 | 12 | 0 | 10 | 81 | 271 | 0 | 265 | 410 | 157 |
| 12 | 68 | 40 | 47 | 12 | 12 | 9 | 81 | 293 | 0 | 265 | 413 | 118 |
| 13 | 70 | 40 | 47 | 12 | 62 | 9 | 81 | 271 | 0 | 265 | 418 | 79 |
| 14 | 72 | 160 | 47 | 12 | 53 | 9 | 81 | 271 | 0 | 265 | 415 | 79 |
| 15 | 73 | 157 | 47 | 12 | 47 | 9 | 81 | 293 | 0 | 268 | 431 | 79 |
| 16 | 75 | 152 | 43 | 16 | 45 | 9 | 81 | 293 | 0 | 284 | 426 | 79 |
| 17 | 218 | 142 | 43 | 20 | 40 | 9 | 81 | 338 | 0 | 289 | 415 | 79 |
| 18 | 306 | 56 | 43 | 22 | 24 | 9 | 105 | 338 | 0 | 304 | 418 | 78 |
| 19 | 297 | 56 | 43 | 26 | 12 | 9 | 131 | 365 | 0 | 331 | 415 | 78 |
| 20 | 248 | 56 | 40 | 33 | 12 | 9 | 160 | 436 | 0 | 340 | 433 | 61 |
| 21 | 100 | 56 | 36 | 36 | 12 | 9 | 145 | 615 | 0 | 335 | 428 | 61 |
| 22 | 93 | 56 | 36 | 36 | 12 | 22 | 160 | 710 | 0 | 463 | 418 | 70 |
| 23 | 93 | 56 | 36 | 36 | 12 | 36 | 176 | 833 | 0 | 463 | 426 | 65 |
| 24 | 93 | 54 | 36 | 33 | 11 | 36 | 176 | 795 | 0 | 398 | 415 | 61 |
| 25 | 93 | 51 | 36 | 33 | 10 | 36 | 230 | 795 | 0 | 423 | 423 | 58 |
| 26 | 93 | 49 | 36 | 36 | 9 | 36 | 271 | 795 | 118 | 433 | 426 | 65 |
| 27 | 93 | 49 | 36 | 40 | 8 | 36 | 338 | 833 | 320 | 466 | 431 | 58 |
| 28 | 97 | 49 | 36 | 43 | 6 | 36 | 361 | 911 | 338 | 415 | 423 | 63 |
| 29 | 95 | 49 | 36 | 76 | ..... | 36 | 463 | 950 | 350 | 388 | 423 | 58 |
| 30 | 95 | 47 | 36 | 72 | ..... | 36 | 491 | 950 | 350 | 388 | 423 | 56 |
| 31 | 41 | ..... | 36 | 70 | ..... | 18 | ..... | 833 | ..... | 388 | 420 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 51 | 32 | 55 | 51 | 87 | 18 | 28 | 157 | 356 | 0 | 1,250 | 102 |
| 2 | 51 | 32 | 53 | 47 | 70 | 18 | 28 | 142 | 356 | 0 | 1,290 | 90 |
| 3 | 49 | 32 | 47 | 43 | 51 | 18 | 28 | 137 | 103 | 0 | 1,490 | 90 |
| 4 | 49 | 32 | 45 | 43 | 43 | 16 | 28 | 131 | 91 | 0 | 598 | 90 |
| 5 | 49 | 32 | 43 | 43 | 40 | 16 | 28 | 137 | 529 | 0 | 145 | 90 |
| 6 | 46 | 33 | 43 | 40 | 36 | 16 | 28 | 157 | 695 | 0 | 145 | 84 |
| 7 | 43 | 33 | 42 | 36 | 36 | 16 | 28 | 206 | 864 | 0 | 230 | 84 |
| 8 | 42 | 32 | 40 | 36 | 33 | 16 | 30 | 306 | 942 | 0 | 230 | 88 |
| 9 | 42 | 32 | 37 | 33 | 33 | 18 | 31 | 354 | 1,020 | 0 | 250 | 91 |
| 10 | 42 | 32 | 36 | 33 | 33 | 18 | 31 | 388 | 1,070 | 0 | 251 | 91 |
| 11 | 43 | 32 | 36 | 30 | 33 | 18 | 31 | 385 | 1,030 | 0 | 515 | 63 |
| 12 | 38 | 32 | 35 | 28 | 30 | 20 | 34 | 395 | 1,050 | 0 | 780 | 26 |
| 13 | 32 | 32 | 35 | 28 | 30 | 20 | 35 | 514 | 1,030 | 0 | 735 | 475 |
| 14 | 36 | 33 | 32 | 28 | 33 | 20 | 36 | 497 | 1,050 | 0 | 705 | 585 |
| 15 | 44 | 32 | 30 | 28 | 30 | 20 | 42 | 538 | 1,090 | 336 | 675 | 590 |
| 16 | 41 | 32 | 28 | 28 | 28 | 20 | 43 | 598 | 1,150 | 413 | 325 | 631 |
| 17 | 36 | 32 | 28 | 28 | 28 | 20 | 51 | 706 | 1,190 | 736 | 239 | 239 |
| 18 | 36 | 36 | 28 | 30 | 25 | 22 | 56 | 903 | 1,190 | 1,100 | 253 | 368 |
| 19 | 41 | 40 | 28 | 40 | 25 | 22 | 56 | 998 | 1,190 | 791 | 150 | 361 |
| 20 | 40 | 47 | 27 | 36 | 25 | 22 | 93 | 954 | 1,150 | 766 | 140 | 361 |
| 21 | 40 | 53 | 33 | 36 | 25 | 28 | 110 | 930 | 1,110 | 732 | 133 | 332 |
| 22 | 36 | 56 | 43 | 36 | 25 | 28 | 113 | 868 | 1,070 | 717 | 127 | 332 |
| 23 | 35 | 51 | 56 | 36 | 25 | 28 | 113 | 787 | 1,050 | 845 | 127 | 197 |
| 24 | 35 | 43 | 70 | 36 | 25 | 28 | 108 | 699 | 322 | 986 | 121 | 193 |
| 25 | 33 | 60 | 93 | 30 | 22 | 30 | 108 | 670 | 81 | 1,110 | 121 | 188 |
| 26 | 31 | 65 | 99 | 40 | 20 | 30 | 108 | 535 | 86 | 1,090 | 146 | 178 |
| 27 | 33 | 68 | 99 | 47 | 20 | 30 | 134 | 474 | 88 | 1,170 | 146 | 161 |
| 28 | 33 | 60 | 87 | 56 | 20 | 30 | 163 | 418 | 93 | 350 | 133 | 146 |
| 29 | 32 | 56 | 70 | 70 | 20 | 30 | 173 | 418 | 0 | 361 | 121 | 146 |
| 30 | 32 | 56 | 60 | 76 | ..... | 28 | 173 | 392 | 0 | 43 | 110 | 146 |
| 31 | 32 | ..... | 51 | 81 | ..... | 28 | ..... | 380 | ..... | 1,330 | 105 | ..... |

NOTE.—Discharge estimated on account of gate operations, Oct. 17, 1918, Feb. 7, 12, 18, Mar. 22, 31, Apr. 1, and June 2, 26, 1919. Discharge ascertained by hourly-discharge method on account of gate operations, Aug. 16 and Sept. 11, 12, 1920. Discharge estimated because of ice, Feb 24 to Mar. 8, 1919. Gates closed Feb. 8–11 and June 3–25, 1919, and June 29 to July 14, 1920.

*Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19 | | | | |
| October | 306 | 41 | 100 | 6,150 |
| November | 160 | 40 | 61.1 | 3,640 |
| December | 47 | 36 | 42.0 | 2,580 |
| January | 76 | 12 | 28.7 | 1,760 |
| February | 65 | 0 | 24.8 | 1,380 |
| March | 36 | 0 | 15.5 | 953 |
| April | 491 | 34 | 157 | 9,340 |
| May | 950 | 230 | 515 | 31,700 |
| June | 550 | 0 | 72.3 | 4,300 |
| July | 466 | 152 | 312 | 19,200 |
| August | 433 | 385 | 410 | 25,200 |
| September | 433 | 56 | 140 | 8,330 |
| The year | 950 | 0 | 158 | 115,000 |
| 1919–20. | | | | |
| October | 51 | 31 | 39.5 | 2,430 |
| November | 68 | 32 | 41.3 | 2,460 |
| December | 99 | 27 | 48.7 | 2,990 |
| January | 81 | 28 | 40.4 | 2,480 |
| February | 87 | 20 | 32.8 | 1,890 |
| March | 30 | 16 | 22.3 | 1,370 |
| April | 173 | 28 | 68.9 | 4,100 |
| May | 998 | 131 | 489 | 30,100 |
| June | 1,190 | 0 | 702 | 41,800 |
| July | 1,330 | 0 | 415 | 25,500 |
| August | 1,490 | 105 | 380 | 23,400 |
| September | 631 | 28 | 221 | 13,200 |
| The year | 1,490 | 0 | 209 | 152,000 |

### CANYON CREEK NEAR MANY GLACIER, MONT.

LOCATION.—At the edge of heavy timber area, half a mile above mouth, in Glacier National Park, and 2 miles southeast of Many Glacier, in Glacier County.

DRAINAGE AREA.—7.0 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 12, 1918, to September 30, 1920.

GAGE.—Stevens continuous water-stage recorder on left bank.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage or by wading.

CHANNEL AND CONTROL.—Bed of stream covered with heavy boulders and cobblestones. Control is riffle about 20 feet below gage; may shift at high stage. Both banks high and are not overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 2.00 feet at 5.30 p. m. May 28 (discharge, 89 second-feet); minimum stage, 0.60 foot September 30 (discharge, 3.9 second-feet).

Maximum stage recorded during year ending September 30, 1920, 1.85 feet at 9 p. m. July 1 (discharge, 86 second-feet); minimum stage, 0.56 foot at 8 p. m. October 4 (discharge, 3.3 second-feet).

1918–1920: Maximum stage recorded, 2.00 feet May 28, 1919 (discharge, 89 second-feet); minimum stage, 0.56 foot October 4, 1919 (discharge, 3.3 second-feet).

ICE.—Station not operated during winter on account of severe ice effect.

DIVERSIONS.—None.

REGULATION.—Some natural storage in small lake at head of creek; no artificial regulation.

ACCURACY.—Stage-discharge relation changed during winter of 1919–20. Two rating curves used, one, applicable May 15 to October 10, 1919, is well defined between 15 and 40 second-feet, the other, applicable May 25 to September 30, 1920, is fairly well defined between 16 and 52 second-feet. Daily gage heights obtained from graph of Stevens water-stage recorder by straight-edge method except for periods November 6, 1918, to May 14, 1919, July 2–8, July 30 to August 14, 1919, October 11, 1919, to May 25, 1920, June 9–25, and September 17–30, 1920, when recorder was not operating. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Records fair.

*Discharge measurements of Canyon Creek near Many Glacier, Mont., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 20 | W. A. Lamb | 1.02 | 17.3 | Aug. 23 | W. A. Lamb | 0.87 | 12.8 |
| 1919. | | | | 27 | Dawson and Jones | .82 | [b] 6.7 |
| May 15 | do | 1.08 | 25.1 | Sept. 19 | B. E. Jones | .73 | [b] 5.2 |
| June 10 | B. E. Jones | 1.25 | 27.9 | 19 | do | .73 | 6.5 |
| July 9 | Jones and Dawson [a] | 1.08 | 19.0 | 1920. | | | |
| 26 | W. A. Lamb | .95 | 14.4 | June 26 | W. A. Lamb | 1.39 | 44.9 |
| 28 | S. G. Dawson | .87 | 10.7 | July 27 | do | 1.25 | 30.0 |
| Aug. 15 | Jones and Haydon [a] | .87 | [b] 7.6 | Aug. 7 | do | 1.17 | 24.2 |

[a] Engineer, Department of the Interior, Canada.

[b] Measurements were made at mouth of canyon half a mile below gage and are in error, owing to seepage loss in that distance. Measurements of Sept. 19 show approximately 20 per cent loss.

*Daily discharge, in second-feet, of Canyon Creek near Many Glacier, Mont., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | |
| 1 | 10 | 9.7 | ..... | 44 | 22 | 17 | 9.4 |
| 2 | 9.7 | 9.4 | ..... | 36 | 20 | 19 | 9.0 |
| 3 | 10 | 8.4 | ..... | 33 | 20 | 20 | 8.4 |
| 4 | 10 | 8.4 | ..... | 34 | 22 | 21 | 7.8 |
| 5 | 12 | 7.5 | ..... | 37 | 24 | 16 | 10 |
| 6 | 12 | 7.5 | ..... | 41 | 28 | 14 | 8.4 |
| 7 | 12 | ..... | ..... | 38 | 23 | 14 | 8.1 |
| 8 | 10 | ..... | ..... | 36 | 19 | 13 | 7.2 |
| 9 | 9.4 | ..... | ..... | 34 | 22 | 15 | 6.3 |
| 10 | 10 | ..... | ..... | 32 | 22 | 14 | 6.0 |
| 11 | 22 | ..... | ..... | 28 | 26 | 13 | 5.8 |
| 12 | 31 | ..... | ..... | 27 | 27 | 13 | 6.6 |
| 13 | 27 | ..... | ..... | 26 | 24 | 13 | 6.9 |
| 14 | 26 | ..... | ..... | 29 | 23 | 12 | 7.2 |
| 15 | 24 | ..... | 22 | 29 | 22 | 12 | 6.9 |
| 16 | 26 | ..... | 25 | 34 | 24 | 11 | 6.6 |
| 17 | 24 | ..... | 29 | 35 | 24 | 12 | 6.3 |
| 18 | 22 | ..... | 31 | 35 | 20 | 12 | 6.3 |
| 19 | 20 | ..... | 36 | 36 | 15 | 12 | 6.6 |
| 20 | 18 | ..... | 53 | 40 | 13 | 12 | 6.6 |
| 21 | 18 | ..... | 56 | 42 | 13 | 12 | 6.0 |
| 22 | 16 | ..... | 57 | 42 | 14 | 11 | 5.2 |
| 23 | 15 | ..... | 71 | 41 | 13 | 11 | 4.5 |
| 24 | 13 | ..... | 61 | 37 | 15 | 10 | 4.5 |
| 25 | 13 | ..... | 51 | 35 | 16 | 10 | 4.3 |
| 26 | 12 | ..... | 52 | 34 | 14 | 9.4 | 5.0 |
| 27 | 12 | ..... | 68 | 34 | 12 | 9.4 | 5.2 |
| 28 | 11 | ..... | 77 | 30 | 11 | 10 | 4.7 |
| 29 | 11 | ..... | 75 | 26 | 11 | 9.4 | 4.5 |
| 30 | 10 | ..... | 71 | 24 | 14 | 8.7 | 3.9 |
| 31 | 10 | ..... | 59 | ..... | 15 | 9.0 | ..... |
| 1919–20. | | | | | | | |
| 1 | 3.7 | ..... | ..... | 25 | 77 | 37 | 11.4 |
| 2 | 3.6 | ..... | ..... | 24 | 76 | 32 | 10.8 |
| 3 | 3.6 | ..... | ..... | 29 | 68 | 29 | 10.4 |
| 4 | 3.4 | ..... | ..... | 32 | 62 | 27 | 10.8 |
| 5 | 3.6 | ..... | ..... | 48 | 56 | 27 | 11.1 |
| 6 | 6.6 | ..... | ..... | 61 | 53 | 26 | 11.4 |
| 7 | 5.0 | ..... | ..... | 68 | 48 | 26 | 11.1 |
| 8 | 6.3 | ..... | ..... | 76 | 48 | 26 | 10.4 |
| 9 | 6.9 | ..... | ..... | ..... | 45 | 26 | 10.0 |
| 10 | 7.2 | ..... | ..... | ..... | 46 | 25 | 10.0 |
| 11 | ..... | ..... | ..... | ..... | 46 | 27 | 16.1 |
| 12 | ..... | ..... | ..... | ..... | 45 | 25 | 50 |
| 13 | ..... | ..... | ..... | ..... | 45 | 25 | 64 |
| 14 | ..... | ..... | ..... | ..... | 45 | 27 | 47 |
| 15 | ..... | ..... | ..... | ..... | 46 | 26 | 39 |
| 16 | ..... | ..... | ..... | ..... | 46 | 25 | 37 |
| 17 | ..... | ..... | ..... | ..... | 44 | 23 | ..... |
| 18 | ..... | ..... | ..... | ..... | 43 | 20 | ..... |
| 19 | ..... | ..... | ..... | ..... | 41 | 14.8 | ..... |
| 20 | ..... | ..... | ..... | ..... | 41 | 13.4 | ..... |
| 21 | ..... | ..... | ..... | ..... | 40 | 12.5 | ..... |
| 22 | ..... | ..... | ..... | ..... | 39 | 12.5 | ..... |
| 23 | ..... | ..... | ..... | ..... | 37 | 13.0 | ..... |
| 24 | ..... | ..... | ..... | ..... | 35 | 13.4 | ..... |
| 25 | ..... | ..... | ..... | ..... | 34 | 13.4 | ..... |
| 26 | ..... | ..... | 34 | 44 | 33 | 13.8 | ..... |
| 27 | ..... | ..... | 33 | 46 | 32 | 13.0 | ..... |
| 28 | ..... | ..... | 34 | 50 | 31 | 12.5 | ..... |
| 29 | ..... | ..... | 34 | 58 | 39 | 11.1 | ..... |
| 30 | ..... | ..... | 32 | 66 | 62 | 11.4 | ..... |
| 31 | ..... | ..... | 29 | ..... | 46 | 11.8 | ..... |

NOTE.—Water-stage recorder not operating, discharge estimated by comparison with flow of Swiftcurrent Creek, July 2–8, and July 30 to Aug. 14, 1919. Mean discharge estimated 20 second-feet Sept. 17–30, 1920, on account of unsatisfactory operation of water-stage recorder. No record obtained Nov. 7, 1918, to May 14, 1919, Oct. 11, 1919, to May 25, 1920, and June 9–25, 1920. Discharge ascertained by means of hourly-discharge method July 29 and Sept. 10, 12, 1920, on account of unusual fluctuation in stage.

*Monthly discharge of Canyon Creek near Many Glacier, Mont., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 7.0 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | Inches. | Acre-feet. |
| 1918-19. | | | | | | |
| October | 31 | 9.4 | 15.7 | 2.24 | 2.58 | 965 |
| November 1-6 | 9.7 | 7.5 | 8.48 | 1.21 | .27 | 101 |
| May 15-31 | 77 | 22 | 52.6 | 7.51 | 4.75 | 1,770 |
| June | 44 | 24 | 34.3 | 4.90 | 5.47 | 2,040 |
| July | 28 | 11 | 19.0 | 2.71 | 3.12 | 1,170 |
| August | 21 | 8.7 | 12.7 | 1.81 | 2.09 | 781 |
| September | 10 | 3.9 | 6.47 | .924 | 1.03 | 385 |
| 1919-20. | | | | | | |
| October 1-10 | 7.2 | 3.4 | 4.99 | .713 | .26 | 99.0 |
| May 26-31 | 34 | 29 | 32.7 | 4.67 | 1.04 | 389 |
| July | 77 | 31 | 46.7 | 6.67 | 7.69 | 2,870 |
| August | 37 | 11.1 | 20.8 | 2.97 | 3.42 | 1,280 |
| September | 64 | 10.0 | 21.4 | 3.03 | 3.41 | 1,270 |

## RED RIVER AT FARGO, N. DAK.

LOCATION.—At dam half a mile above highway bridge connecting Front Street, Fargo, N. Dak., with Moorhead, Minn., 10 miles above mouth of Sheyenne River, in Cass County.

DRAINAGE AREA.—6,020 square miles.

RECORDS AVAILABLE.—May 27, 1901, to September 30, 1920.

GAGE.—Vertical staff attached to tree on left bank about 6 rods above the dam; vertical staff for use at low stages attached at upper end of fishway at left end of dam; the dam has settled slightly and lowest point of crest of dam is now about 0.7 foot above gage datum; read by W. B. Stevenson and R. T. Jacobsen. Prior to September 1, 1914, gage readings were obtained from a vertical staff attached to the breakwater for the center pier of Front Street bridge; this gage is still maintained and used by the Weather Bureau, but can not be read accurately without a field glass and has a less permanent control than the gage now used. At the same stage, after complete submergence of the dam, readings on the Front Street gage are numerically about 10.4 feet greater than on the gage now used.

DISCHARGE MEASUREMENTS.—Made from footbridge a few feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Control is timber and steel crib dam, rock filled, below gage; has settled a few inches since construction. At extreme low stage the fall over the dam is about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 2.7 feet March 22, April 5 and 7, and May 12 (discharge, 630 second-feet); minimum discharge, estimated 29 second-feet February 12 (stage-discharge relation affected by ice).

Maximum stage recorded during year ending September 30, 1920, 13.5 feet at 2 p. m. March 27 (discharge, 6,200 second-feet); minimum discharge, estimated 55 second-feet December 5 (stage-discharge relation affected by ice).

1901–1920: Maximum stage recorded, 29.8 feet March 30, 1907 (stage-discharge relation affected by ice); maximum open-water stage recorded, 17.34 feet July 11, 1916 (discharge, 7,740 second-feet); minimum stage recorded, 1.0 foot February 11, 1918 (discharge not determined).

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—No power plants or storage above station within 60 miles; storage not great enough to noticeably affect the discharge at station.

ACCURACY.—Stage-discharge relation changed during 1919 owing to settling of the dam; affected by ice during 1919 and 1920. Two rating curves used, one, applicable October 1, 1918, to April 30, 1919, is well defined between 60 and 4,400 second-feet, the other, applicable March 1, 1919, to September 30, 1920, is well defined between 45 and 4,400 second-feet. Gage read to tenths once daily except during periods indicated in footnote to tables of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records good; other records fair.

*Discharge measurements of Red River at Fargo, N. Dak., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Apr. 4 | E. F. Chandler | 2.52 | 555 | Apr. 17 | W. L. Stockwell | 3.00 | 758 |
| May 16 | H. A. Noble | 2.54 | 546 | 18 | do | 2.90 | 738 |
| July 5 | E. F. Chandler | 2.06 | 388 | May 29 | do | 3.40 | 884 |
| Aug. 22 | do | 1.69 | 191 | June 16 | E. F. Chandler | 4.28 | 1,800 |
| Dec. 26 | Noble and Stockwell | a1.70 | 160 | Aug. 23 | do | 2.28 | 372 |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 91 | 104 | 105 | 107 | 93 | 70 | 520 | 245 | 468 | 440 | 259 | 228 |
| 2 | 90 | 98 | 104 | 103 | 90 | 60 | 508 | 300 | 380 | 400 | 320 | 248 |
| 3 | 88 | 93 | 104 | 99 | 87 | 50 | 555 | 380 | 360 | 360 | 320 | 242 |
| 4 | 71 | 88 | 103 | 95 | 85 | 46 | 530 | 393 | 340 | 350 | 320 | 214 |
| 5 | 78 | 83 | 103 | 92 | 83 | 42 | 630 | 407 | 360 | 340 | 360 | 210 |
| 6 | 83 | 96 | 102 | 89 | 75 | 44 | 630 | 420 | 360 | 350 | 420 | 238 |
| 7 | 96 | 109 | 102 | 86 | 67 | 45 | 630 | 440 | 360 | 360 | 400 | 233 |
| 8 | 90 | 122 | 95 | 83 | 59 | 47 | 530 | 508 | 360 | 360 | 340 | 228 |
| 9 | 83 | 135 | 88 | 75 | 51 | 54 | 530 | 530 | 360 | 340 | 320 | 220 |
| 10 | 81 | 148 | 82 | 67 | 43 | 61 | 508 | 605 | 360 | 320 | 300 | 206 |
| 11 | 81 | 160 | 76 | 59 | 36 | 70 | 485 | 618 | 360 | 330 | 280 | 186 |
| 12 | 81 | 172 | 74 | 54 | 29 | 75 | 485 | 630 | 360 | 340 | 308 | 172 |
| 13 | 76 | 116 | 73 | 49 | 36 | 90 | 475 | 605 | 360 | 350 | 316 | 200 |
| 14 | 96 | 110 | 72 | 45 | 43 | 110 | 465 | 580 | 360 | 360 | 280 | 205 |
| 15 | 96 | 140 | 71 | 41 | 51 | 139 | 456 | 555 | 360 | 340 | 273 | 210 |
| 16 | 96 | 140 | 70 | 45 | 59 | 172 | 447 | 530 | 360 | 300 | 276 | 200 |
| 17 | 96 | 143 | 69 | 49 | 67 | 206 | 438 | 508 | 340 | 245 | 318 | 189 |
| 18 | 91 | 146 | 81 | 53 | 75 | 240 | 429 | 508 | 320 | 228 | 360 | 214 |
| 19 | 96 | 166 | 93 | 55 | 83 | 276 | 420 | 508 | 320 | 320 | 320 | 228 |
| 20 | 104 | 166 | 105 | 57 | 91 | 370 | 410 | 485 | 316 | 289 | 262 | 200 |
| 21 | 113 | 198 | 117 | 59 | 99 | 490 | 400 | 462 | 320 | 259 | 234 | 196 |
| 22 | 102 | 166 | 130 | 61 | 105 | 630 | 400 | 440 | 360 | 228 | 214 | 192 |
| 23 | 107 | 88 | 143 | 78 | 111 | 620 | 360 | 440 | 400 | 217 | 224 | 200 |
| 24 | 110 | 86 | 139 | 94 | 117 | 615 | 340 | 420 | 530 | 273 | 228 | 228 |
| 25 | 94 | 83 | 135 | 113 | 124 | 590 | 400 | 410 | 508 | 200 | 231 | 200 |
| 26 | 96 | 105 | 131 | 107 | 131 | 580 | 400 | 400 | 462 | 192 | 210 | 172 |
| 27 | 99 | 110 | 127 | 101 | 100 | 570 | 400 | 400 | 605 | 185 | 224 | 186 |
| 28 | 102 | 110 | 123 | 96 | 80 | 565 | 400 | 400 | 605 | 178 | 245 | 194 |
| 29 | 140 | 122 | 119 | 91 | ..... | 555 | 400 | 360 | 534 | 186 | 196 | 203 |
| 30 | 125 | 105 | 115 | 94 | ..... | 544 | 312 | 458 | 462 | 224 | 186 | 228 |
| 31 | 110 | ..... | 111 | 96 | ..... | 532 | ..... | 555 | ..... | 242 | 207 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 203 | 192 | 228 | ..... | ..... | ..... | 2,270 | 945 | 945 | 1,300 | 605 | 400 |
| 2 | 210 | 227 | 210 | ..... | ..... | ..... | 1,440 | 890 | 945 | 1,370 | 605 | 440 |
| 3 | 203 | 262 | 158 | ..... | ..... | ..... | 1,090 | 835 | 945 | 1,370 | 580 | 440 |
| 4 | 210 | 196 | 106 | ..... | ..... | ..... | 440 | 808 | 945 | 1,370 | 580 | 400 |
| 5 | 219 | 248 | 55 | ..... | ..... | ..... | 440 | 780 | 945 | 1,330 | 530 | 420 |
| 6 | 228 | 245 | 87 | ..... | ..... | ..... | 780 | 780 | 1,000 | 1,300 | 555 | 440 |
| 7 | 234 | 238 | 119 | ..... | ..... | ..... | 890 | 780 | 1,060 | 1,240 | 580 | 485 |
| 8 | 206 | 228 | 152 | ..... | ..... | ..... | 918 | 808 | 1,030 | 1,210 | 580 | 462 |
| 9 | 220 | 219 | 186 | ..... | ..... | ..... | 890 | 736 | 1,060 | 1,150 | 580 | 420 |
| 10 | 154 | 210 | 182 | ..... | ..... | ..... | 1,060 | 655 | 1,060 | 1,180 | 530 | 440 |
| 11 | 189 | 205 | 178 | ..... | ..... | ..... | 1,040 | 730 | 1,440 | 1,090 | 530 | 440 |
| 12 | 202 | 200 | 175 | ..... | ..... | ..... | 1,030 | 780 | 1,400 | 1,000 | 440 | 440 |
| 13 | 214 | 196 | 175 | ..... | ..... | ..... | 1,030 | 780 | 1,550 | 945 | 462 | 440 |
| 14 | 203 | 192 | 175 | ..... | ..... | ..... | 862 | 1,000 | 1,690 | 972 | 485 | 420 |
| 15 | 210 | 208 | 175 | ..... | ..... | 280 | 835 | 1,000 | 1,690 | 945 | 474 | 420 |
| 16 | 192 | 225 | 175 | ..... | ..... | 390 | 835 | 1,030 | 1,600 | 945 | 462 | 420 |
| 17 | 175 | 242 | 175 | ..... | ..... | 510 | 780 | 1,060 | 1,600 | 945 | 462 | 420 |
| 18 | 160 | 276 | 155 | ..... | ..... | 630 | 730 | 1,030 | 1,480 | 918 | 462 | 420 |
| 19 | 176 | 292 | 135 | ..... | ..... | 780 | 730 | 1,000 | 1,370 | 890 | 485 | 420 |
| 20 | 192 | 300 | 115 | ..... | ..... | 835 | 680 | 945 | 1,370 | 862 | 485 | 420 |
| 21 | 200 | 320 | 125 | ..... | ..... | 975 | 680 | 945 | 1,370 | 835 | 485 | 420 |
| 22 | 210 | 320 | 130 | ..... | ..... | 1,120 | 680 | 1,000 | 1,240 | 780 | 462 | 508 |
| 23 | 203 | 316 | 135 | ..... | ..... | 2,980 | 680 | 1,060 | 1,180 | 730 | 440 | 508 |
| 24 | 245 | 312 | 140 | ..... | ..... | 4,240 | 680 | 1,120 | 1,180 | 730 | 447 | 508 |
| 25 | 210 | 320 | 145 | ..... | ..... | 4,920 | 730 | 1,090 | 1,090 | 705 | 455 | 580 |
| 26 | 150 | 300 | 150 | ..... | ..... | 5,600 | 780 | 1,120 | 1,060 | 680 | 462 | 555 |
| 27 | 90 | 290 | 155 | ..... | ..... | 6,120 | 780 | 1,060 | 1,060 | 655 | 485 | 530 |
| 28 | 102 | 280 | 160 | ..... | ..... | 6,120 | 1,000 | 1,060 | 1,060 | 580 | 462 | 530 |
| 29 | 115 | 263 | 165 | ..... | ..... | 5,720 | 945 | 1,000 | 1,060 | 580 | 441 | 508 |
| 30 | 151 | 246 | 170 | ..... | ..... | 4,840 | 918 | 987 | 1,120 | 555 | 420 | 485 |
| 31 | 178 | ..... | 175 | ..... | ..... | 3,720 | ..... | 972 | ..... | 605 | 400 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 23, 1918, to Mar. 15, 1919, and Nov. 26, 1919, to Mar. 18, 1920; discharge for days when gage was read ascertained by correcting daily gage height for backwater from ice and applying corrected gage height to rating table and interpolating for days when gage was not read, except during period Jan. 1 to Mar. 14, 1920, for which mean discharge was estimated as follows: Jan. 1–31, 155 second-feet; Feb. 1–29, 150 second-feet; Mar. 1–14, 160 second-feet. Discharge interpolated on account of missing gage readings, Oct. 2, 8, 15–16, 20, 27, 30, Nov. 1–4, 6–11, 17, 24, Dec. 1–6, 8–10, 12–16, 18–22, 1918; Mar. 16–18, 20, 21, 23–25, 27, 28, 30, 31, Apr. 1, 6, 13–18, 20, 27, May 4, 5, 11, 18, 21, 25, 27, 30, June 1, 8, 15, 22, 29, July 4, 6, 11–13, 20, 21, 27, Aug. 3, 10, 17, 24, 31, Sept. 1, 7, 14, 21, 28, Oct. 5, 12, 19, 26, Nov. 2, 9, 11–13, 15, 16, 23, 1919; Mar. 21, Apr. 11, 25, May 2, 4, 9, 16, 23, 30, June 6, 13, 20, 27, July 4, 5, 11, 18, 25, Aug. 1, 8, 15, 22, 24, 25, 29, and Sept. 5, 12, 19, 26, 1920. During periods of ice effect the gage was read on the following days only: Dec. 23, 1918; Jan. 8, 11, 15, 18, 22, 25, 29, 31, Feb. 5, 8, 12, 19, 21, 26, Mar. 5, 8, 12, 15, Nov. 26, 28, Dec. 2, 5, 9, 12, 17, 20, 31, 1919; and Jan. 3, 6, 10, 13, 18, 21, Mar. 15, 18, 1920.

*Monthly discharge of Red River at Fargo, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19. | | | | |
| October | 140 | 71 | 95.5 | 5,870 |
| November | 198 | 83 | 124 | 7,380 |
| December | 143 | 69 | 102 | 6,270 |
| January | 113 | 41 | 77.2 | 4,750 |
| February | 131 | 29 | 77.5 | 4,300 |
| March | 630 | 42 | 276 | 17,000 |
| April | 630 | 312 | 463 | 27,600 |
| May | 630 | 245 | 468 | 28,800 |
| June | 605 | 316 | 398 | 23,700 |
| July | 440 | 178 | 294 | 18,100 |
| August | 420 | 186 | 282 | 17,300 |
| September | 248 | 172 | 209 | 12,400 |
| The year | 630 | 29 | 240 | 173,000 |
| 1919–20. | | | | |
| October | 245 | 90 | 189 | 11,600 |
| November | 320 | 192 | 252 | 15,000 |
| December | 228 | 55 | 154 | 9,470 |
| January | | | 155 | 9,530 |
| February | | | 150 | 8,630 |
| March | 6,120 | | 1,680 | 103,000 |
| April | 2,270 | 440 | 888 | 52,800 |
| May | 1,120 | 655 | 929 | 57,100 |
| June | 1,690 | 945 | 1,220 | 72,600 |
| July | 1,370 | 555 | 960 | 59,000 |
| August | 605 | 400 | 498 | 30,600 |
| September | 580 | 400 | 458 | 27,300 |
| The year | 6,120 | 55 | 629 | 457,000 |

**RED RIVER AT GRAND FORKS, N. DAK.**

LOCATION.—At Northern Pacific Railway bridge between Grand Forks, N. Dak., and East Grand Forks, Minn., half a mile below mouth of Red Lake River, in Grand Forks County.

DRAINAGE AREA.—25,000 square miles.

RECORDS AVAILABLE.—May 26, 1901, to September 30, 1920; gage-height records have been kept by the United States Engineer Corps since 1882 and a few discharge measurements were made by them in early years.

GAGE.—Vertical staff gage with enameled face, attached to ice-breaker below center pier of Northern Pacific Railway bridge; installed by United States Weather Bureau during winter of 1916–17 beside old Geological Survey staff gage which was used prior to 1917, but at a datum 5 feet higher. The observer, H. L. Hayes, adds 5 feet to gage readings to reduce them to datum of old Geological Survey gage. Another vertical staff gage attached to the ice-breaker beside the enameled gage, and at the same datum, is used by the United States Engineer Corps. Prior to 1918, when the railway bridge was partially rebuilt, a chain gage, attached to the middle span of the bridge, was maintained for use in case the staff gages were destroyed. This chain gage has not been replaced since 1918.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge a quarter of a mile above gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 23.2 feet July 8 (discharge, 13,600 second-feet); minimum discharge, estimated 263 second-feet February 27 and 28 and March 1 (stage-discharge relation affected by ice).

Maximum discharge during year ending September 30, 1920, estimated 30,300 second-feet March 31 (stage-discharge relation affected by ice); minimum discharge, estimated 590 second-feet February 21 and 23 (stage-discharge relation affected by ice).

1882–1920: Maximum stage recorded, 50.2 feet April 10, 1897 (discharge, 43,000 second-feet); minimum discharge, about 100 second-feet during early part of February, 1912 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice. The ice cover is usually complete and smooth from late in November until about the beginning of April and the flow steady with few fluctuations; in determining flow during spring break-up, however, corrections amounting to several feet at times must be applied to gage heights before applying them to open-water rating table owing to backwater from ice jams.

DIVERSIONS.—None.

REGULATION.—No power plants above with sufficient storage to cause noticeable variations in the flow.

ACCURACY.—Stage-discharge relation affected by ice and by slight shifts in control. One rating curve used during 1919 and 1920; well defined between 640 and 16,300 second-feet. Gage read to tenths twice daily during 1919 and during open-water season of 1920 and usually twice a week during period of ice effect in 1920. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Red River at Grand Forks, N. Dak., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 12 | Chandler and Strand... | 3.51 | 419 | Dec. 23 | Chandler and Noble.... | a 6.27 | 736 |
| 1919. | | | | 1920. | | | |
| Jan. 25 | H. A. Noble..... | 4.31 | 364 | Mar. 1 | Noble and Stockwell... | a 7.42 | 860 |
| Feb. 15 | .....do..... | 4.13 | 324 | Apr. 24 | Stockwell and Knudson | 13.51 | 4,950 |
| Apr. 19 | Noble and Cady..... | 11.81 | 4,520 | Aug. 3 | Chandler and Foster... | 6.68 | 1,820 |
| Aug. 15 | E. F. Chandler..... | 11.31 | 4,390 | Sept. 28 | E. E. Foster..... | 5.70 | 1,090 |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1918-19.** | | | | | | | | | | | | |
| 1 | 413 | 558 | 689 | 622 | 388 | 263 | 5,500 | 3,940 | 1,690 | 2,380 | 2,860 | 1,910 |
| 2 | 388 | 558 | 655 | 590 | 413 | 281 | 6,160 | 4,000 | 1,690 | 2,860 | 2,740 | 1,850 |
| 3 | 388 | 558 | 689 | 527 | 440 | 300 | 6,890 | 3,940 | 1,640 | 3,700 | 2,620 | 1,800 |
| 4 | 364 | 558 | 689 | 497 | 440 | 320 | 7,520 | 3,880 | 1,640 | 5,380 | 2,500 | 1,740 |
| 5 | 364 | 558 | 689 | 440 | 413 | 341 | 7,980 | 3,880 | 1,640 | 7,600 | 2,380 | 1,690 |
| 6 | 364 | 558 | 724 | 413 | 388 | 341 | 7,240 | 3,820 | 1,690 | 9,850 | 2,860 | 1,640 |
| 7 | 341 | 590 | 724 | 364 | 364 | 364 | 6,890 | 3,820 | 1,690 | 12,200 | 3,340 | 1,590 |
| 8 | 341 | 590 | 760 | 364 | 341 | 364 | 6,620 | 3,760 | 1,740 | 13,400 | 3,400 | 1,590 |
| 9 | 320 | 590 | 724 | 364 | 320 | 364 | 6,100 | 3,700 | 1,850 | 12,800 | 3,340 | 1,590 |
| 10 | 320 | 590 | 689 | 341 | 320 | 364 | 5,620 | 3,700 | 2,020 | 11,700 | 3,100 | 1,540 |
| 11 | 341 | 590 | 655 | 341 | 320 | 388 | 5,740 | 3,640 | 2,140 | 10,500 | 2,920 | 1,490 |
| 12 | 364 | 590 | 655 | 341 | 320 | 413 | 5,680 | 3,640 | 2,140 | 9,510 | 2,800 | 1,440 |
| 13 | 388 | 622 | 622 | 341 | 320 | 413 | 5,860 | 3,580 | 2,080 | 8,680 | 2,740 | 1,390 |
| 14 | 388 | 655 | 622 | 364 | 320 | 413 | 5,860 | 3,580 | 2,020 | 8,120 | 2,680 | 1,340 |
| 15 | 413 | 689 | 622 | 364 | 320 | 413 | 5,740 | 3,520 | 1,910 | 7,750 | 2,920 | 1,250 |
| 16 | 440 | 724 | 622 | 341 | 300 | 440 | 5,380 | 3,520 | 1,800 | 7,450 | 3,580 | 1,300 |
| 17 | 468 | 760 | 622 | 349 | 300 | 468 | 5,020 | 3,460 | 1,740 | 7,170 | 4,480 | 1,300 |
| 18 | 440 | 760 | 622 | 356 | 320 | 497 | 4,780 | 3,400 | 1,640 | 6,890 | 4,780 | 1,250 |
| 19 | 413 | 796 | 655 | 364 | 341 | 527 | 4,660 | 3,340 | 1,590 | 6,490 | 4,660 | 1,250 |
| 20 | 388 | 833 | 655 | 388 | 364 | 558 | 4,540 | 3,220 | 1,540 | 6,160 | 4,540 | 1,250 |
| 21 | 388 | 796 | 689 | 388 | 388 | 590 | 4,180 | 3,100 | 1,490 | 5,860 | 4,420 | 1,250 |
| 22 | 364 | 724 | 689 | 413 | 364 | 622 | 3,940 | 2,980 | 1,440 | 5,500 | 4,300 | 1,250 |
| 23 | 388 | 655 | 689 | 440 | 388 | 655 | 3,820 | 2,860 | 1,390 | 5,140 | 3,940 | 1,250 |
| 24 | 413 | 590 | 689 | 413 | 320 | 833 | 3,820 | 2,680 | 1,440 | 4,720 | 3,460 | 1,250 |
| 25 | 440 | 622 | 689 | 413 | 300 | 1,340 | 3,760 | 2,500 | 1,590 | 4,240 | 2,980 | 1,250 |
| 26 | 468 | 655 | 689 | 388 | 281 | 2,020 | 3,700 | 2,380 | 1,590 | 3,880 | 2,680 | 1,250 |
| 27 | 468 | 689 | 655 | 388 | 263 | 2,620 | 3,700 | 2,260 | 1,690 | 3,640 | 2,440 | 1,250 |
| 28 | 497 | 724 | 655 | 388 | 263 | 3,580 | 3,760 | 2,140 | 1,850 | 3,400 | 2,260 | 1,250 |
| 29 | 497 | 724 | 689 | 364 | ..... | 3,460 | 3,880 | 2,020 | 2,020 | 3,280 | 2,140 | 1,250 |
| 30 | 527 | 689 | 689 | 364 | ..... | 5,200 | 3,940 | 1,910 | 2,140 | 3,220 | 2,020 | 1,250 |
| 31 | 527 | ..... | 655 | 341 | ..... | 5,350 | ..... | 1,800 | ..... | 3,040 | 1,970 | ..... |
| **1919-20.** | | | | | | | | | | | | |
| 1 | 1,300 | 1,120 | 833 | ..... | ..... | 724 | 29,800 | 4,720 | 3,520 | 4,180 | 2,140 | 1,070 |
| 2 | 1,300 | 1,120 | 796 | ..... | ..... | 710 | 28,500 | 4,660 | 3,460 | 4,300 | 2,080 | 1,620 |
| 3 | 1,300 | 1,120 | 796 | ..... | ..... | 696 | 26,900 | 4,540 | 3,520 | 4,420 | 2,020 | 1,030 |
| 4 | 1,300 | 1,120 | 760 | ..... | ..... | 682 | 23,800 | 4,420 | 3,580 | 4,540 | 1,910 | 1,030 |
| 5 | 1,300 | 1,120 | 760 | ..... | ..... | 668 | 19,900 | 4,300 | 3,580 | 4,540 | 1,800 | 990 |
| 6 | 1,300 | 1,120 | 760 | ..... | ..... | 655 | 16,600 | 4,180 | 3,640 | 4,420 | 1,690 | 990 |
| 7 | 1,250 | 1,120 | 760 | ..... | ..... | 842 | 14,200 | 4,060 | 3,640 | 4,240 | 1,590 | 990 |
| 8 | 1,250 | 1,120 | 724 | ..... | ..... | 1,030 | 12,800 | 3,940 | 3,700 | 4,060 | 1,490 | 990 |
| 9 | 1,200 | 1,160 | 724 | ..... | ..... | 1,030 | 12,100 | 3,820 | 3,700 | 4,120 | 1,490 | 990 |
| 10 | 1,200 | 1,160 | 724 | ..... | ..... | 1,030 | 11,500 | 3,700 | 4,000 | 3,760 | 1,440 | 990 |
| 11 | 1,160 | 1,120 | 724 | ..... | ..... | 1,030 | 10,900 | 3,580 | 4,540 | 3,520 | 1,490 | 990 |
| 12 | 1,160 | 1,070 | 724 | ..... | ..... | 1,030 | 10,100 | 3,520 | 5,500 | 3,400 | 1,490 | 950 |
| 13 | 1,160 | 990 | 724 | ..... | ..... | 1,080 | 9,420 | 3,460 | 6,300 | 3,340 | 1,490 | 950 |
| 14 | 1,120 | 990 | 724 | ..... | ..... | 1,080 | 9,000 | 3,400 | 6,550 | 3,220 | 1,440 | 910 |
| 15 | 1,120 | 990 | 724 | ..... | ..... | 1,160 | 8,420 | 3,400 | 6,750 | 3,160 | 1,390 | 871 |
| 16 | 1,070 | 1,030 | 689 | ..... | ..... | 1,200 | 8,120 | 3,400 | 6,890 | 3,100 | 1,340 | 833 |
| 17 | 1,070 | 1,070 | 689 | ..... | ..... | 1,250 | 8,200 | 3,340 | 7,030 | 3,100 | 1,340 | 833 |
| 18 | 1,120 | 1,120 | 689 | ..... | ..... | 1,300 | 8,200 | 3,280 | 6,620 | 3,100 | 1,300 | 833 |
| 19 | 1,120 | 1,160 | 724 | ..... | ..... | 1,340 | 7,980 | 3,280 | 6,100 | 3,040 | 1,300 | 871 |
| 20 | 1,160 | 1,200 | 760 | ..... | ..... | 1,440 | 7,520 | 3,340 | 5,680 | 2,980 | 1,250 | 1,250 |
| 21 | 1,160 | 1,250 | 796 | ..... | ..... | 1,590 | 7,080 | 3,400 | 5,280 | 2,920 | 1,250 | 1,080 |
| 22 | 1,120 | 1,300 | 833 | ..... | ..... | 1,970 | 6,680 | 3,400 | 4,840 | 2,860 | 1,200 | 910 |
| 23 | 1,120 | 1,340 | 841 | ..... | ..... | 4,780 | 6,360 | 3,400 | 4,420 | 2,800 | 1,160 | 910 |
| 24 | 1,070 | 1,200 | 848 | ..... | ..... | 10,000 | 5,920 | 3,400 | 4,120 | 2,740 | 1,160 | 1,020 |
| 25 | 1,070 | 1,200 | 856 | ..... | ..... | 16,600 | 5,440 | 3,460 | 3,880 | 2,620 | 1,160 | 1,200 |
| 26 | 1,120 | 1,120 | 863 | ..... | ..... | 21,800 | 5,320 | 3,520 | 3,700 | 2,560 | 1,160 | 1,300 |
| 27 | 1,120 | 1,080 | 871 | ..... | ..... | 24,700 | 5,140 | 3,580 | 3,520 | 2,500 | 1,160 | 1,340 |
| 28 | 1,160 | 950 | 871 | ..... | ..... | 27,500 | 5,080 | 3,640 | 3,460 | 2,440 | 1,160 | 1,300 |
| 29 | 1,160 | 910 | 871 | ..... | ..... | 29,300 | 4,960 | 3,700 | 3,580 | 2,320 | 1,120 | 1,300 |
| 30 | 1,120 | 870 | 849 | ..... | ..... | 30,200 | 4,840 | 3,700 | 3,940 | 2,260 | 1,120 | 1,300 |
| 31 | 1,120 | ..... | 827 | ..... | ..... | 30,300 | ..... | 3,580 | ..... | 2,200 | 1,070 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 14, 1918, to Apr. 4, 1919, and Nov. 4, 1919, to Mar. 31, 1920; discharge ascertained, for days when gage was read, by correcting mean daily gage height for backwater from ice and applying corrected gage height to rating table, and interpolating for days when gage was not read, except during period Jan. 1 to Feb. 29, 1920, for which mean discharge was estimated as follows: Jan. 1-31, 690 second-feet; Feb. 1-29, 670 second-feet. During periods of ice effect the gage was not read on the following days: Jan. 17, 18, Dec. 21, 23-26, 28, 30, 31, 1919; Jan. 1, 2, 4, 6-9, 11-16, 18, 20-23, 25-31, Feb. 3-6, 8-15, 17-20, 22, 24-27, 29, and Mar. 2-5, 7, 9-12, 14, 1920.

*Monthly discharge of Red River at Grand Forks, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19. | | | | |
| October | 527 | 320 | 407 | 25,000 |
| November | 833 | 558 | 653 | 38,900 |
| December | 760 | 622 | 673 | 41,400 |
| January | 622 | 341 | 399 | 24,500 |
| February | 440 | 263 | 344 | 19,100 |
| March | 5,350 | 263 | 1,100 | 67,600 |
| April | 7,980 | 3,700 | 5,280 | 314,000 |
| May | 4,000 | 1,800 | 3,220 | 198,000 |
| June | 2,140 | 1,390 | 1,750 | 104,000 |
| July | 13,400 | 2,380 | 6,660 | 410,000 |
| August | 4,780 | 1,970 | 3,160 | 194,000 |
| September | 1,910 | 1,250 | 1,420 | 84,500 |
| The year | 13,400 | 263 | 2,100 | 1,520,000 |
| 1919–20. | | | | |
| October | 1,300 | 1,070 | 1,170 | 71,900 |
| November | 1,340 | 870 | 1,110 | 66,000 |
| December | 871 | 689 | 779 | 47,900 |
| January | | | 690 | 42,400 |
| February | | | 670 | 38,500 |
| March | 30,300 | 655 | 7,050 | 433,000 |
| April | 29,800 | 4,840 | 11,400 | 678,000 |
| May | 4,720 | 3,280 | 3,710 | 228,000 |
| June | 7,030 | 3,460 | 4,630 | 276,000 |
| July | 4,540 | 2,200 | 3,310 | 204,000 |
| August | 2,140 | 1,070 | 1,430 | 87,900 |
| September | 1,340 | 833 | 1,040 | 61,900 |
| The year | 30,300 | | 3,080 | 2,240,000 |

### BOIS DES SIOUX RIVER NEAR TENNEY, MINN.

LOCATION.—Near center of sec. 22, T. 130 N., R. 47 W., at Soo Railway bridge, 2 miles east of Fairmount, N. Dak., 5 miles west of Tenney, Wilkin County, Minn., and 15 miles below outlet of Lake Traverse.

DRAINAGE AREA.—1,460 square miles.

RECORDS AVAILABLE.—April 1 to September 6, 1919, and April 1 to September 30, 1920.

GAGE.—Vertical staff attached to face of eighth pile-pier from left end of railway bridge, used August 24 to September 30, 1920. Vertical staff attached to sixth pile-pier from left end of railway bridge, used April 1 to August 23, 1920; at same datum as staff gage on eighth pile-pier. Vertical staff attached underneath right end of highway bridge half a mile above railway bridge, used April 1 to September 6, 1919. Owing to change in slope of water surface, the gage at the highway bridge does not read the same as the gage at the railway bridge for other than low stages. Gage readers, B. W. Schouweiler, J. H. Bolton, and Math Schmit.

DISCHARGE MEASUREMENTS.—Made from highway bridge half a mile upstream from gage.

CHANNEL AND CONTROL.—Bed composed of silt and fine clay; overgrown with aquatic plants which may, at low stages, materially affect stage-discharge relation. Shifts not likely to occur for normal velocities are not swift enough to erode channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period April 1 to September 6, 1919, 4.1 feet August 4–6 (discharge, 77 second-feet); minimum stage, 1.5 feet April 5 (discharge, 6 second-feet).

Maximum discharge recorded during period April 1 to September 30, 1920, 214 second-feet April 2 and 3 (gage height, 5.0 feet); gage height June 11 and 12 was 5.2 feet but stage-discharge relation was affected by obstructions in channel; minimum stage, 3.3 feet September 21–23 (discharge, 43 second-feet).

1919–20: Maximum discharge recorded during period occurred during 1920; minimum discharge occurred during 1919.

ICE.—Station not operated during winter.

DIVERSIONS.—None.

REGULATION.—No reservoirs or power plants affect the flow. No large tributaries enter between outlet of Lake Traverse and the station and abrupt changes in stage are unusual. Extensive ditching and drainage work in the area above station within recent years, undoubtedly affects the distribution of flow.

ACCURACY.—Stage-discharge relation affected, at low stages, by heavy growth of aquatic plants. Rating curve used during period of record in 1919, referred to gage at highway bridge, fairly well defined between 7 and 47 second-feet. Rating curve used during period of record in 1920, referred to gages at railway bridge, fairly well defined between 6 and 166 second-feet. All gages read to half-tenths once daily except on days indicated in footnote to tables of daily discharge. Daily discharge ascertained by applying daily gage height to rating table and interpolating for days when gage was not read except for periods when flow was affected by growth of aquatic plants for which it was ascertained by applying to rating table the daily gage height corrected for backwater, the amount of which had been determined by discharge measurements, and interpolating for days when gage was not read. Records good except for periods when flow was affected by growth of aquatic plants for which they are fair.

COOPERATION.—Station maintained during 1919 in cooperation with the Bureau of Public Roads, Department of Agriculture, and during 1920 in cooperation with the Department of Drainage and Waters, State of Minnesota.

*Discharge measurements of Bois des Sioux River near Tenney, Minn., during the years ending September 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | | Discharge. |
|---|---|---|---|---|
| | | Highway bridge. | Railway bridge. | |
| 1919. | | *Feet.* | *Feet.* | *Sec.-ft.* |
| Apr. 5[a] | E. F. Chandler | 1.56 | 1.56 | 6.9 |
| May 17[a] | H. A. Noble | 2.21 | 2.36 | 9.8 |
| July 2 | D. S. Helmick[b] | 2.40 | ..... | 23.4 |
| 4[a] | E. F. Chandler | 2.79 | 3.38 | 23.4 |
| 16 | Simons[b] and Helmick | 3.38 | ..... | 45 |
| 18 | E. F. Chandler | 3.38 | 3.98 | 42 |
| Aug. 16 | B. S. Clayton[b] | 3.60 | ..... | 45 |
| 1920. | | | | |
| May 9 | E. F. Chandler | 3.52 | 4.08 | 133 |
| 21 | W. L. Stockwell | 4.02 | 4.64 | 169 |
| June 17 | E. F. Chandler | 4.38 | 4.81 | 143 |
| Aug. 24 | .....do | 3.89 | 3.85 | 56 |

[a] Measurement made with float.
[b] Engineer, Bureau of Public Roads, Department of Agriculture.

*Daily discharge, in second-feet, of Bois des Sioux River near Tenney, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | | 1920. | | | | | | |
| 1 | 6 | 6.5 | 10 | 18 | 53 | 32 | 1 | 194 | 140 | 148 | 82 | 58 | 55 |
| 2 | 6 | 6.5 | 10 | 17 | 55 | 31 | 2 | 214 | 140 | 157 | 82 | 58 | 57 |
| 3 | 6 | 6.5 | 10 | 19 | 65 | 29 | 3 | 214 | 140 | 166 | 82 | 56 | 58 |
| 4 | 6 | 8 | 10 | 25 | 77 | 28 | 4 | 194 | 140 | 175 | 82 | 56 | 58 |
| 5 | 6 | 10 | 9 | 28 | 77 | 27 | 5 | 175 | 140 | 175 | 79 | 56 | 58 |
| 6 | 6.2 | 10 | 9 | 30 | 77 | 27 | 6 | 175 | 132 | 175 | 76 | 53 | 57 |
| 7 | 7.6 | 10 | 9 | 36 | 74 | ..... | 7 | 175 | 132 | 157 | 70 | 53 | 55 |
| 8 | 9 | 11.5 | 9 | 36 | 74 | ..... | 8 | 180 | 132 | 166 | 68 | 50 | 53 |
| 9 | 7.5 | 13 | 9 | 39 | 71 | ..... | 9 | 184 | 132 | 175 | 67 | 50 | 51 |
| 10 | 6.5 | 13 | 9 | 39 | 65 | ..... | 10 | 180 | 154 | 175 | 64 | 50 | 49 |
| 11 | 9 | 13 | 9 | 41 | 62 | ..... | 11 | 178 | 175 | 184 | 64 | 43 | 48 |
| 12 | 8 | 15 | 8 | 39 | 60 | ..... | 12 | 175 | 184 | 184 | 64 | 43 | 48 |
| 13 | 7 | 17 | 8 | 39 | 60 | ..... | 13 | 175 | 194 | 166 | 66 | 43 | 48 |
| 14 | 6.5 | 19 | 8 | 43 | 57 | ..... | 14 | 166 | 184 | 166 | 67 | 43 | 47 |
| 15 | 6.5 | 17 | 8 | 43 | 55 | ..... | 15 | 166 | 175 | 157 | 67 | 43 | 46 |
| 16 | 7 | 17 | 8 | 43 | 53 | ..... | 16 | 166 | 175 | 148 | 64 | 43 | 47 |
| 17 | 7 | 17 | 8 | 43 | 51 | ..... | 17 | 162 | 175 | 148 | 64 | 43 | 48 |
| 18 | 7 | 17 | 8 | 43 | 49 | ..... | 18 | 160 | 175 | 132 | 64 | 43 | 48 |
| 19 | 6.5 | 15 | 8 | 45 | 47 | ..... | 19 | 157 | 166 | 124 | 64 | 46 | 48 |
| 20 | 7 | 15 | 8 | 45 | 45 | ..... | 20 | 166 | 166 | 116 | 67 | 48 | 46 |
| 21 | 7 | 15 | 8 | 45 | 43 | ..... | 21 | 157 | 166 | 109 | 64 | 48 | 43 |
| 22 | 7 | 15 | 39 | 47 | 41 | ..... | 22 | 157 | 166 | 102 | 64 | 48 | 43 |
| 23 | 7 | 15 | 21 | 47 | 39 | ..... | 23 | 157 | 166 | 95 | 64 | 50 | 43 |
| 24 | 7 | 11.5 | 19 | 47 | 39 | ..... | 24 | 157 | 166 | 88 | 64 | 50 | 46 |
| 25 | 7 | 11.5 | 19 | 47 | 38 | ..... | 25 | 157 | 166 | 88 | 62 | 50 | 48 |
| 26 | 7 | 11.5 | 19 | 47 | 37 | ..... | 26 | 157 | 157 | 82 | 61 | 50 | 50 |
| 27 | 7 | 10 | 19 | 47 | 36 | ..... | 27 | 148 | 157 | 82 | 61 | 50 | 49 |
| 28 | 7 | 10 | 19 | 47 | 35 | ..... | 28 | 143 | 157 | 82 | 61 | 50 | 48 |
| 29 | 6.5 | 10 | 19 | 47 | 34 | ..... | 29 | 140 | 157 | 82 | 61 | 52 | 47 |
| 30 | 6.5 | 10 | 19 | 47 | 33 | ..... | 30 | 140 | 157 | 82 | 58 | 53 | 46 |
| 31 | ..... | 10 | ..... | 51 | 33 | ..... | 31 | ..... | 157 | ..... | 58 | 54 | ..... |

NOTE.—Discharge interpolated on account of lack of gage readings Apr. 7, July 5, Aug. 18, 19, 21, 22, 25–29, 31, Sept. 1–5, 1919; Apr. 4, 11, 18, 25, May 10, 16, 21, 29, June 3, 15, 20, 22, July 5, 8, 13, 25, 27, Aug. 1, 9, 12, 13, 17, 19, 25–27, 29, 31, Sept. 1, 2, 4, 6–10, 14, 16, 22, 24, 27, 29, 1920. Mean discharge Apr. 1–5, 1919, estimated 6 second-feet. Stage-discharge relation affected by growth of aquatic plants during April and June, 1919, and from May 14 to Sept. 30, 1920.

*Monthly discharge of Bois des Sioux River near Tenney, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| April | 9 | 6 | 6.91 | 411 |
| May | 19 | 6.5 | 12.5 | 769 |
| June | 39 | 8 | 12.5 | 744 |
| July | 51 | 17 | 39.7 | 2,440 |
| August | 77 | 33 | 52.7 | 3,240 |
| September 1–6 | 32 | 27 | 29.0 | 345 |
| The period | | | | 7,940 |
| 1920. | | | | |
| April | 214 | 140 | 169 | 10,100 |
| May | 194 | 132 | 159 | 9,780 |
| June | 184 | 82 | 136 | 8,090 |
| July | 82 | 58 | 67 | 4,120 |
| August | 58 | 43 | 49 | 3,010 |
| September | 58 | 43 | 50 | 2,980 |
| The period | | | | 38,100 |

### MUSTINKA RIVER ABOVE WHEATON, MINN.

LOCATION.—On line between secs. 7 and 8, T. 127 N., R. 46 W., at steel-concrete highway bridge 1 mile upstream from Chicago, Milwaukee & St. Paul Railway bridge, 1½ miles northeast of Wheaton, Traverse County, and 8 miles above Lake Traverse, into which the river discharges.

DRAINAGE AREA.—776 square miles.[3]

RECORDS AVAILABLE.—March 23 to September 30, 1917, and June 25, 1919, to September 30, 1920. June 7 to November 30, 1916, at point about 3½ miles downstream.

GAGE.—Chain gage attached to highway bridge; read by Vernon Heggen. An auxiliary staff gage, for use during floods, is attached to the Chicago, Milwaukee & St. Paul Railway bridge 1 mile downstream from chain gage.

DISCHARGE MEASUREMENTS.—Made from highway bridge to which gage is attached or from steel highway bridge just below Chicago, Milwaukee & St. Paul Railway bridge; about 1¼ miles downstream from gage. Measuring section at gage poor on account of angle of current; best section at steel highway bridge below the railway bridge. Flow of drainage ditch which carries water around gage must be included in all measurements made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of firm gravel overlain with thin deposits of clay and silt; practically permanent. Control not well defined. Slope of river from station to Lake Traverse is so slight that the stage-discharge relation may possibly be affected by changes of stage of the lake.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period June 25 to September 30, 1919, 7.37 feet June 25 (discharge, 559 second-feet); minimum stage, 1.12 feet September 25 (discharge, 0.3 second-foot).

Maximum discharge during year ending September 30, 1920, 970 second-feet May 11 (gage height, 9.5 feet); gage height 11.02 feet March 24 (stage-discharge relation affected by ice); minimum stage recorded, 1.10 feet October 9 (discharge, 0.2 second-foot).

1917; 1919–20: Maximum stage recorded during periods, 14.7 feet April 1, 1917 (discharge, 2,340 second-feet); minimum stage, 1.10 feet October 9, 1919 (discharge, 0.2 second-foot).

ICE.—Station not operated during winter.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice in March, 1920. One rating curve used during 1919 and 1920; fairly well defined between 4 and 2,400 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Records good.

COOPERATION.—Station operated during 1919 by Bureau of Public Roads, Department of Agriculture, and during 1920 in cooperation with the Department of Drainage and Waters, State of Minnesota.

*Discharge measurements of Mustinka River above Wheaton, Minn., during the period June 25, 1919, to Sept. 30, 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| June 25 | P. T. Simons [a] | 7.38 | 460 | May 9 | E. F. Chandler | 1.78 | 10.6 |
| 27 | D. S. Helmick [a] | 5.35 | 234 | 20 | W. L. Stockwell | 2.34 | 35 |
| | | | | June 17 | E. F. Chandler | 3.39 | 85 |
| 1920. | | | | Aug. 24 | ....do.... | 1.49 | 3.3 |
| Mar. 25 | P. T. Simons | 7.68 | 622 | | | | |

[a] Engineer, Bureau of Public Roads, Department of Agriculture.

[3] Formerly published as about 900 square miles. Revised measurement made on map compiled by the State.

*Daily discharge, in second-feet, of Mustinka River above Wheaton, Minn., for the period June 25, 1919, to Sept. 30, 1920.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | 1919. | | | | |
| 1 | | 59 | 7.6 | 1.4 | 16 | | 28 | 4.8 | 1.2 |
| 2 | | 47 | 6.4 | 1.7 | 17 | | 24 | 7.6 | 1.1 |
| 3 | | 44 | 8.0 | 1.2 | 18 | | 22 | 6.0 | 1.0 |
| 4 | | 36 | 9.5 | .8 | 19 | | 21 | 6.0 | .9 |
| 5 | | 34 | 9.0 | 1.1 | 20 | | 18 | 6.0 | .9 |
| 6 | | 38 | 7.6 | 1.2 | 21 | | 15 | 4.6 | .8 |
| 7 | | 40 | 6.8 | 1.1 | 22 | | 12 | 3.7 | .6 |
| 8 | | 42 | 6.0 | .8 | 23 | | 13 | 4.0 | .4 |
| 9 | | 48 | 5.6 | 1.7 | 24 | | 9 | 3.0 | .3 |
| 10 | | 52 | 5.2 | 1.4 | 25 | 559 | 8 | 2.4 | .3 |
| 11 | | 48 | 4.0 | 1.1 | 26 | 403 | 8 | 2.4 | .3 |
| 12 | | 41 | 3.7 | .9 | 27 | 268 | 8 | 2.4 | .3 |
| 13 | | 35 | 7.2 | .9 | 28 | 174 | 7 | 1.6 | .4 |
| 14 | | 31 | 6.0 | 1.4 | 29 | 114 | 8 | 2.7 | .3 |
| 15 | | 29 | 5.2 | 1.4 | 30 | 78 | 7 | 5.6 | .4 |
| | | | | | 31 | | 8 | 3.0 | |

| Day. | Oct. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | |
| 1 | 0.8 | | 91 | 14 | 19 | 215 | 14 | 1.8 |
| 2 | .6 | | 63 | 12 | 55 | 169 | 13 | 1.7 |
| 3 | .6 | | 88 | 11 | 88 | 84 | 12 | 2.2 |
| 4 | .5 | | 53 | 13 | 90 | 87 | 12 | 2.4 |
| 5 | .5 | | 42 | 11 | 98 | 85 | 12 | 2.7 |
| 6 | .4 | | 53 | 11 | 84 | 87 | 11 | 2.9 |
| 7 | .5 | | 40 | 11 | 74 | 206 | 10 | 3.0 |
| 8 | .5 | | 38 | 9 | 60 | 186 | 10 | 3.2 |
| 9 | .2 | | 18 | 9 | 71 | 157 | 9 | 3.4 |
| 10 | .5 | | 21 | 140 | 88 | 117 | 8 | 3.0 |
| 11 | .6 | | 20 | 970 | 160 | 91 | 8 | 3.7 |
| 12 | .8 | | 17 | 544 | 160 | 84 | 7 | 4.0 |
| 13 | .9 | | 17 | 216 | 134 | 117 | 7 | 2.7 |
| 14 | 1.4 | | 15 | 115 | 106 | 166 | 7 | 1.2 |
| 15 | 1.7 | | 13 | 75 | 91 | 201 | 6 | 1.2 |
| 16 | 3.0 | | 12 | 55 | 83 | 110 | 6 | 1.1 |
| 17 | 2.4 | | 11 | 40 | 89 | 91 | 3.8 | 1.1 |
| 18 | 2.7 | | 11 | 34 | 107 | 58 | 4.0 | 1.0 |
| 19 | 3.7 | | 10 | 29 | 102 | 45 | 3.7 | 1.0 |
| 20 | 4.0 | 91 | 11 | 25 | 88 | 60 | 3.4 | 1.0 |
| 21 | 4.0 | 70 | 14 | 21 | 134 | 48 | 2.9 | 1.1 |
| 22 | 3.7 | 106 | 18 | 22 | 187 | 40 | 3.0 | 1.2 |
| 23 | 3.7 | 543 | 26 | 17 | 178 | 35 | 3.0 | 1.6 |
| 24 | 2.7 | 673 | 39 | 16 | 72 | 28 | 3.2 | 1.9 |
| 25 | 2.4 | 501 | 36 | 13 | 62 | 27 | 3.2 | 2.2 |
| 26 | 3.0 | 324 | 32 | 15 | 52 | 23 | 3.2 | 2.2 |
| 27 | 2.7 | 207 | 26 | 13 | 47 | 22 | 1.9 | 2.2 |
| 28 | 2.5 | 186 | 20 | 13 | 95 | 18 | 1.9 | 2.3 |
| 29 | 2.5 | 171 | 19 | 13 | 215 | 18 | 1.9 | 2.3 |
| 30 | 2.5 | 142 | 15 | 13 | 214 | 17 | 2.0 | 2.4 |
| 31 | 2.5 | 120 | | 16 | | 15 | 1.9 | |

NOTE.—Stage-discharge relation affected by ice Mar. 20-25, 1920; discharge ascertained by means of observer's notes, weather records, and one discharge measurement. Discharge estimated, Oct. 27–31, 1919, on account of lack of gage readings.

*Monthly discharge of Mustinka River above Wheaton, Minn., for the period June 25, 1919, to Sept. 30, 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| June 25–30 | 559 | 78 | 266 | 3,170 |
| July | 59 | 7 | 27.1 | 1,670 |
| August | 9.5 | 1.6 | 5.28 | 325 |
| September | 1.7 | .3 | .91 | 56 |
| The period | | | | 5,220 |
| 1919–20. | | | | |
| October | 4.0 | .2 | 1.89 | 115 |
| March 20–31 | 673 | 70 | 261 | 6,220 |
| April | 91 | 10 | 29.6 | 1,760 |
| May | 970 | 9 | 81.2 | 4,990 |
| June | 215 | 19 | 103 | 6,160 |
| July | 215 | 15 | 87.3 | 5,370 |
| August | 14 | 1.9 | 6.29 | 387 |
| September | 4.0 | 1.0 | 2.12 | 126 |

### WILD RICE RIVER NEAR WILD RICE, N. DAK.

LOCATION.—In T. 138 N., R. 49 W., at highway bridge 3 miles southwest of Wild Rice, Cass County.

DRAINAGE AREA.—1,840 square miles; determined by Department of Agriculture.

RECORDS AVAILABLE.—April 8 to August 31, 1919, when station was discontinued.

GAGE.—Vertical staff attached to highway bridge; read by John H. Hexom.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or from a highway bridge at Wild Rice.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 3.7 feet April 11 (discharge, 98 second-feet); minimum stage, 0.2 foot August 15 (discharge, 0.1 second-foot).

ACCURACY.—Stage-discharge relation probably permanent. Rating curve fairly well defined between 15 and 100 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

COOPERATION.—Station operated and base data furnished by Bureau of Public Roads, Department of Agriculture.

*Discharge measurements of Wild Rice River near Wild Rice, N. Dak., during the period Apr. 8 to Aug. 31, 1919.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Apr. 8 | Paul Funderhide | 3.3 | 81 | June 28 | Lake and Engerude | 3.12 | 56 |
| 12 | do | 3.5 | 87 | July 1 | Dan Helmick | 1.60 | 22 |
| June 24 | P. T. Simons | 2.05 | 27 | | | | |

*Daily discharge, in second-feet, of Wild Rice River near Wild Rice, N. Dak., for the period Apr. 8 to Aug. 31, 1919.*

| Day. | Apr. | May. | June. | Aug. | Day. | Apr. | May. | June. | Aug. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 20 | 13 | 23 | 16 | 53 | 65 | 9 | 0.1 |
| 2 | ..... | 20 | 13 | 23 | 17 | 45 | 53 | 9 | .3 |
| 3 | ..... | 20 | 11 | 15 | 18 | 45 | 49 | 7 | .5 |
| 4 | ..... | 23 | 11 | 7 | 19 | 35 | 45 | 7 | .5 |
| 5 | ..... | 23 | 11 | 4 | 20 | 32 | 42 | 6 | 1.0 |
| 6 | ..... | 26 | 9 | 3 | 21 | 32 | 35 | 6 | .5 |
| 7 | ..... | 26 | 9 | 1.5 | 22 | 29 | 32 | 6 | .5 |
| 8 | 78 | 32 | 9 | 1.0 | 23 | 26 | 6 | 11 | .3 |
| 9 | 88 | 61 | 9 | .5 | 24 | 26 | 6 | 32 | .3 |
| 10 | 98 | 65 | 9 | .5 | 25 | 26 | 6 | 65 | .1 |
| 11 | 98 | 74 | 11 | .5 | 26 | 26 | 4 | 69 | .1 |
| 12 | 88 | 83 | 13 | .3 | 27 | 23 | 4 | 53 | .1 |
| 13 | 78 | 83 | 13 | .3 | 28 | 23 | 4 | 38 | .1 |
| 14 | 65 | 83 | 13 | .3 | 29 | 23 | 6 | 29 | .3 |
| 15 | 61 | 74 | 11 | .1 | 30 | 23 | 9 | 20 | 1.0 |
| | | | | | 31 | ..... | 13 | ..... | 3 |

NOTE.—Gage not read during July.

*Monthly discharge of Wild Rice River near Wild Rice, N. Dak., for the period Apr. 8 to Aug. 31, 1919.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 8-30 | 98 | 23 | 48.7 | 2,220 |
| May | 83 | 4 | 35.2 | 2,160 |
| June | 69 | 6 | 17.7 | 1,050 |
| August | 23 | .1 | 2.86 | 176 |

### SHEYENNE RIVER AT VALLEY CITY, N. DAK.

LOCATION.—At steel footbridge near Elk's House, 40 rods west of Northern Pacific Railway depot at Valley City, Barnes County.

DRAINAGE AREA.—4,300 square miles.

RECORDS AVAILABLE.—March 24 to August 29, 1919, when station was discontinued.

GAGE.—Vertical staff attached to steel pier at south end of footbridge; read by K. C. Schmidt.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and fine clay. Control is a concrete dam about half a mile below gage. A broad-crested weir on the crest of the dam acts as control at low stages. The weir crest is 2 feet wide, 49 feet long, and at an elevation 1 foot below crest of dam; elevation of weir crest, referred to gage datum, 6.38 feet. Submergence of the dam begins at stage about 8 feet, and at 10 feet submergence is practically complete.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 14.9 feet April 18 (discharge, 2,750 second-feet); minimum stage, 6.14 feet August 28 (discharge, 3 second-feet).

ICE.—Station operated for only a short period during winter.

REGULATION.—No dams above have sufficient storage capacity to affect the flow for more than a single day.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 3 and 2,800 second-feet. Gage read to tenths or hundredths once daily during periods of high water; readings obtained irregularly during other periods. Daily discharge for days when gage was read, ascertained by applying daily gage height to rating table except for period March 24 to April 3, when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table the daily gage height corrected for backwater from ice. Discharge interpolated for days when gage was not read. Records fair.

COOPERATION.—Station maintained in cooperation with the Bureau of Public Roads, Department of Agriculture.

*Discharge measurements of Sheyenne River at Valley City, N. Dak., during the period Mar. 24 to Aug. 29, 1919.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Mar. 30[a] | E. F. Chandler | 8.11 | 468 | Apr. 17 | J. H. Lake | 14.59 | 2,660 |
| Apr. 6 | do | 10.32 | 1,450 | 19 | do | 14.86 | 2,740 |
| 9 | Lake[b] and Lubins[b] | 9.95 | 1,240 | 22 | P. T. Simons[b] | 12.95 | 2,120 |
| 11 | Clayton[b] and Lubins[b] | 9.00 | 1,120 | 25 | J. W. Bliss[b] | 9.98 | 1,250 |
| 12 | do | 9.00 | 1,120 | May 5 | K. C. Schmidt[b] | 7.98 | 473 |
| 13 | J. H. Lake | 13.06 | 2,360 | 18 | H. A. Noble | 7.84 | 306 |
| 14 | H. A. Noble | 11.33 | 1,760 | July 3 | E. F. Chandler | 7.27 | 84 |
| 16 | J. H. Lake | 13.55 | 2,500 | Aug. 29 | do | 6.14 | 3.3 |
| 16 | do | 13.94 | 2,440 | Sept. 19 | B. S. Clayton | 6.56 | 32 |
| 17 | do | 14.38 | 2,480 | | | | |

[a] Measurement made from Normal School bridge 1,500 feet above gage; stage-discharge relation probably affected by ice.
[b] Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

*Daily discharge, in second-feet, of Sheyenne River at Valley City, N. Dak., for the period Mar. 24 to Aug. 29, 1919.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Day. | Mar. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 630 | 1,020 | ..... | ..... | ..... | 16 | ..... | 2,370 | 365 | 207 | ..... | ..... |
| 2 | ..... | 800 | 925 | ..... | ..... | 64 | 17 | ..... | 2,610 | 300 | 190 | ..... | ..... |
| 3 | ..... | 1,010 | 445 | ..... | 115 | ..... | 18 | ..... | 2,750 | 275 | 176 | ..... | ..... |
| 4 | ..... | 1,230 | 445 | ..... | ..... | ..... | 19 | ..... | 2,690 | 275 | 166 | ..... | 27 |
| 5 | ..... | 1,410 | 445 | ..... | ..... | ..... | 20 | ..... | 2,490 | 300 | 156 | ..... | ..... |
| 6 | ..... | 1,440 | 445 | ..... | ..... | ..... | 21 | ..... | 2,260 | 275 | 147 | ..... | ..... |
| 7 | ..... | 1,410 | 630 | ..... | ..... | ..... | 22 | ..... | 2,080 | 300 | 134 | ..... | ..... |
| 8 | ..... | 1,360 | 585 | ..... | ..... | ..... | 23 | ..... | 1,740 | ..... | 118 | ..... | ..... |
| 9 | ..... | 1,360 | 445 | ..... | ..... | ..... | 24 | 100 | 1,570 | ..... | 107 | ..... | ..... |
| 10 | ..... | 1,170 | 445 | ..... | ..... | 36 | 25 | 122 | 1,360 | ..... | 176 | ..... | ..... |
| 11 | ..... | 1,080 | 445 | ..... | ..... | ..... | 26 | 122 | 1,330 | ..... | 134 | ..... | ..... |
| 12 | ..... | 1,080 | 445 | 260 | ..... | ..... | 27 | 122 | 1,280 | ..... | 122 | ..... | ..... |
| 13 | ..... | 1,410 | 445 | 239 | ..... | ..... | 28 | 176 | 1,280 | ..... | 127 | ..... | 3 |
| 14 | ..... | 1,770 | 445 | 218 | ..... | ..... | 29 | 300 | 1,170 | ..... | 147 | ..... | 7 |
| 15 | ..... | 2,200 | 365 | 212 | ..... | ..... | 30 | 365 | 1,110 | ..... | 142 | ..... | ..... |
| | | | | | | | 31 | 445 | ..... | ..... | ..... | ..... | ..... |

NOTE.—Discharge interpolated on account of lack of gage readings, May 1, 10, June 13, 15, 19, 20. Gage not read on days for which no discharge is given.

*Monthly discharge of Sheyenne River at Valley City, N. Dak., for the period Mar. 24 to Aug. 29, 1919.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 24-31 | 445 | 100 | 219 | 3,480 |
| April | 2,750 | 630 | 1,580 | 94,000 |
| May 1-22 | 1,020 | 275 | 405 | 24,900 |
| June 12-30 | 260 | 107 | 198 | 11,800 |

### SHEYENNE RIVER AT HAGGART, N. DAK.

LOCATION.—At private wagon bridge a fourth of a mile north of Northern Pacific Railway station at Haggart, Cass County.

DRAINAGE AREA.—5,400 square miles.

RECORDS AVAILABLE.—March 29, 1902, to June 30, 1907, and March 21 to August 31, 1919, when station was discontinued.

GAGE.—Vertical staff bolted to pile-pier of the wagon bridge; read by employee of United States Department of Agriculture.

DISCHARGE MEASUREMENTS.—Made from wagon bridge.

CHANNEL AND CONTROL.—Bed composed of silt and clay; fairly firm but subject to gradual changes.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 16.8 feet April 28 (discharge, 2,220 second-feet); minimum stage, 3.6 feet August 23–31 (discharge, 52 second-feet).

1902–1907: Maximum discharge recorded during period, 2,030 second-feet April 9–11, 1902 (gage height, 18.0 feet); minimum stage, 2.6 feet August 18, 1903 (discharge, 19 second-feet).

ICE.—Station operated for only a short period during winter.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 50 and 2,260 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period March 21 to April 2, when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily gage height corrected for backwater from ice, and except for period June 1–30, when gage was not read, for which mean discharge was estimated at 305 second-feet, by comparison with flow at Valley City. Records excellent during flood season; fair for other periods.

COOPERATION.—Station maintained and base data furnished by Bureau of Public Roads, Department of Agriculture.

*Discharge measurements of Sheyenne River at Haggart, N. Dak., during the period Mar. 21 to Aug. 31, 1919.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Apr. 8 | Simons and Lake | 11.61 | 1,240 | Apr. 24 | Simons and Funderhide | 15.67 | 1,990 |
| 10 | J. H. Lake | 12.60 | 1,440 | 26 | B. S. Clayton | 16.55 | 2,100 |
| 11 | Lake and Lubins | 12.85 | 1,460 | 28 | do | 16.74 | 2,260 |
| 14 | J. H. Lake | 12.75 | 1,350 | May 7 | Clayton and Lubins | 9.84 | 777 |
| 18 | do | 12.54 | 1,190 | July 1 | D. S. Helmick | 5.00 | 189 |
| 21 | do | 14.19 | 1,730 | Aug. 27 | Clayton and Lake | 3.77 | 65 |
| 23 | do | 15.18 | 1,920 | | | | |

*Daily discharge, in second-feet, of Sheyenne River at Haggart, N. Dak., for the period Mar. 21 to Aug. 31, 1919.*

| Day. | Mar. | Apr. | May. | July. | Aug. | Day. | Mar. | Apr. | May. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 965 | 1,860 | 212 | 86 | 16 | ..... | 1,140 | 774 | 190 | 68 |
| 2 | ..... | 1,260 | 1,660 | 212 | 86 | 17 | ..... | 1,020 | 710 | 190 | 68 |
| 3 | ..... | 1,460 | 1,480 | 234 | 86 | 18 | ..... | 1,220 | 695 | 179 | 60 |
| 4 | ..... | 1,560 | 1,300 | 258 | 86 | 19 | ..... | 1,460 | 680 | 212 | 60 |
| 5 | ..... | 1,860 | 1,120 | 234 | 86 | 20 | ..... | 1,620 | 621 | 190 | 60 |
| 6 | ..... | 1,420 | 1,020 | 168 | 86 | 21 | 60 | 1,680 | 607 | 201 | 60 |
| 7 | ..... | 1,220 | 858 | 179 | 86 | 22 | 126 | 1,800 | 537 | 190 | 60 |
| 8 | ..... | 1,200 | 841 | 168 | 86 | 23 | 168 | 1,880 | 537 | 179 | 52 |
| 9 | ..... | 1,240 | 710 | 146 | 77 | 24 | 136 | 1,980 | 523 | 168 | 52 |
| 10 | ..... | 1,240 | 774 | 146 | 77 | 25 | 157 | 2,060 | 495 | 157 | 52 |
| 11 | ..... | 1,420 | 807 | 168 | 77 | 26 | 201 | 2,140 | 469 | 157 | 52 |
| 12 | ..... | 1,440 | 824 | 179 | 68 | 27 | 270 | 2,180 | 430 | 146 | 52 |
| 13 | ..... | 1,440 | 807 | 157 | 68 | 28 | 282 | 2,220 | 404 | 126 | 52 |
| 14 | ..... | 1,440 | 807 | 146 | 68 | 29 | 469 | 2,180 | 404 | 116 | 52 |
| 15 | ..... | 1,400 | 774 | 168 | 68 | 30 | 621 | 2,060 | 391 | 126 | 52 |
| | | | | | | 31 | 790 | ..... | 391 | 136 | 52 |

*Monthly discharge of Sheyenne River at Haggart, N. Dak., for the period Mar. 21 to Aug. 31, 1919.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 21-31 | 790 | 60 | 298 | 6,500 |
| April | 2,220 | 965 | 1,570 | 93,400 |
| May | 1,860 | 391 | 784 | 48,200 |
| June | ..... | ..... | 305 | 18,100 |
| July | 258 | 116 | 175 | 10,800 |
| August | 86 | 52 | 67.6 | 4,160 |
| The period | ..... | ..... | ..... | 181,000 |

### DEVILS LAKE NEAR DEVILS LAKE, N. DAK.

LOCATION.—At biologic station of University of North Dakota, on shore of Creels Bay, 6 miles southwest of city of Devils Lake, in Ramsey County.

DRAINAGE AREA.—The theoretical drainage area of the lake is about 3,710 square miles. In years of ordinary rainfall water reaches the lake from only a very small part of this area, for most of it drains into local depressions and small lakes, where it remains until lost by evaporation. By survey in 1883, the length of the lake was found to be 35 miles, and its area 115 square miles. It was a continuous body of water then, but at present it is divided, by sand bars and roadways, into three separate large lakes and at least 8 smaller ones, the combined area of which is only about 52 square miles. In 1920 the elevation of the water surface of some of these lakes differed by 3 or 4 feet. At present, the greatest depth of water is about 20 feet.

RECORDS AVAILABLE.—June 7, 1901, to September 30, 1920 (fragmentary). A few records were obtained in earlier years.

GAGE.—Staff gage attached to pier at biologic station. Occasionally the gage is damaged or removed by ice during spring break-up, but is replaced by reference to several bench marks in the vicinity. Zero of gage, 1,416.2 feet above sea-level. Read occasionally by employees of the biologic station.

REGULATION.—The lake has no outlet. The stage of the lake shows the relation between evaporation from the lake surface and the inflow from the surrounding country and gives an indication of whether the run-off has been affected by the settlement and cultivation of the land surface of the drainage area.

COOPERATION.—Records furnished by North Dakota Biological Survey.

*Gage height of Devils Lake near Devils Lake, N. Dak., during the years 1919 and 1920.*

| Date. | Gage height. | Date. | Gage height. |
|---|---|---|---|
| | *Feet.* | | *Feet.* |
| July 24, 1919 | 6.3 | Aug. 12, 1920 | 5.3 |
| June 22, 1920 | 5.9 | Oct. —, 1920 | 4.6 |

*Summarized record of gage heights of Devils Lake near Devils Lake, N. Dak., for the period 1867–1918.*

| Date. | Gage height. | Date. | Gage height. | Date. | Gage height. |
|---|---|---|---|---|---|
| | *Feet.* | | *Feet.* | | *Feet.* |
| 1867 | 26.7 | July 16, 1905 | 13.5 | Aug. 14, 1912 | [a]9.7 |
| 1879 | 22.9 | Nov. 29, 1905 | 12.6 | May 30, 1912 | 8.8 |
| 1883 | 22.8 | June 7, 1906 | [a]13.0 | May 5, 1913 | [a]10.1 |
| 1887 | 15.4 | Nov. 16, 1906 | 11.6 | November, 1913 | 8.7 |
| 1890 | 13.0 | July 9, 1907 | 12.5 | July 7, 1914 | 8.9 |
| August, 1896 | 13.0 | Nov. 15, 1907 | 11.3 | Sept. 19, 1914 | 8.0 |
| June 8, 1901 | 12.4 | Apr. 21, 1908 | 11.7 | June 29, 1915 | 7.6 |
| Sept. 19, 1901 | 11.6 | November, 1908 | 10.2 | Sept. 7, 1915 | 6.8 |
| June 13, 1902 | 14.1 | June 6, 1909 | 11.0 | July 7, 1916 | 7.9 |
| Nov. 15, 1902 | 13.0 | Oct. 25, 1909 | 10.0 | Nov. 5, 1916 | [b]6.9 |
| May 29, 1903 | [a]13.1 | June 25, 1910 | 9.7 | Apr. 15, 1917 | 7.1 |
| Nov. 15, 1903 | 11.8 | Sept. 1, 1910 | 8.6 | Nov. 10, 1917 | 5.6 |
| June 8, 1904 | [a]13.4 | Aug. 14, 1911 | 8.7 | May 7, 1918 | [a]5.7 |
| Nov. 29, 1904 | 12.6 | Sept. 30, 1911 | 8.5 | November, 1918[c] | 4.7 |

[a] Same stage occurred on other days during year.
[b] About 6.9 feet.
[c] About Nov. 22.

NOTE.—Gage heights given for period 1901 to 1918, are maximum and minimum stages obtained from occasional gage readings made generally during period April to November of each year.

### RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 33, T. 154 N., R. 43 W., a third of a mile below dam at Thief River Falls, Pennington County, and 1 mile below mouth of Thief River, which enters from right.

DRAINAGE AREA.—3,430 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1918, and March 25 to September 30, 1920.

GAGE.—Inclined staff gage on right bank; read by Dedrick Knutson. During period April 2 to August 18, when it was impossible to install inclined gage on account of high stage of river, a series of temporary vertical staff gages was used.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet above gage.

CHANNEL AND CONTROL.—Gravel and small boulders; practically permanent.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 9.2 feet April 16 (discharge, 3,700 second-feet); minimum stage, 4.3 feet August 17 and 18 (discharge, 290 second-feet).

1909–1918: Maximum open-water stage recorded, 12.2 feet April 19–21, 1916 (discharge, 7,040 second-feet); minimum discharge recorded, no flow, July 17 and August 27, 1911; caused by regulation.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A short distance above station is a dam owned by Hansen & Barzen Milling Co. and the city lighting plant. The variation in load on the turbines, due to the operation of the lighting plant (at night) and of the mill (chiefly during the day), causes fluctuations in stage at the gage.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 20 and 5,600 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period March 25 to April 9, when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table the daily gage height corrected for backwater from ice, and except for March 31 and July 23 for which discharge was interpolated on account of lack of gage readings. Daily discharge for some days in error on account of fluctuations in stage caused by operation of lighting plant and mill just above gage. Open-water records for days of no fluctuation excellent; records for other periods fair.

COOPERATION.—Station maintained in cooperation with the Department of Drainage and Waters, E. V. Willard, commissioner.

*Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending Sept. 30, 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Apr. 2 | H. A. Noble | 8.96 | 3,220 | June 13 | W. L. Stockwell | 7.69 | 2,360 |
| 27 | do | 6.86 | 1,630 | 25 | E. F. Chandler | 5.95 | 1,070 |
| May 16 | W. L. Stockwell | 5.71 | 856 | Aug. 19 | Chandler and Smith | 5.06 | 607 |

*Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1920.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | ..... | 2,910 | 1,300 | 1,110 | 890 | 695 | 515 |
| 2 | ..... | 3,100 | 1,230 | 1,050 | 840 | 695 | 515 |
| 3 | ..... | 2,110 | 1,170 | 1,050 | 840 | 650 | 538 |
| 4 | ..... | 2,820 | 1,170 | 995 | 840 | 605 | 515 |
| 5 | ..... | 3,000 | 1,170 | 1,050 | 790 | 605 | 472 |
| 6 | ..... | 2,820 | 1,050 | 1,050 | 790 | 650 | 493 |
| 7 | ..... | 2,370 | 1,110 | 1,050 | 740 | 650 | 493 |
| 8 | ..... | 2,280 | 1,050 | 1,050 | 740 | 472 | 472 |
| 9 | ..... | 2,370 | 1,050 | 1,720 | 695 | 605 | 451 |
| 10 | ..... | 2,370 | 995 | 3,000 | 740 | 695 | 431 |
| 11 | ..... | 2,200 | 940 | 2,730 | 605 | 605 | 431 |
| 12 | ..... | 2,110 | 1,050 | 2,550 | 940 | 560 | 515 |
| 13 | ..... | 3,200 | 1,050 | 1,870 | 940 | 515 | 538 |
| 14 | ..... | 3,100 | 995 | 1,870 | 890 | 431 | 560 |
| 15 | ..... | 3,400 | 1,050 | 1,720 | 890 | 357 | 560 |
| 16 | ..... | 3,700 | 890 | 1,720 | 840 | 323 | 560 |
| 17 | ..... | 3,200 | 940 | 1,570 | 740 | 290 | 515 |
| 18 | ..... | 2,730 | 890 | 1,300 | 560 | 290 | 472 |
| 19 | ..... | 2,200 | 940 | 1,170 | 695 | 560 | 515 |
| 20 | ..... | 2,280 | 840 | 1,050 | 740 | 493 | 515 |
| 21 | ..... | 1,950 | 940 | 1,050 | 650 | 493 | 560 |
| 22 | ..... | 2,080 | 940 | 1,050 | 650 | 515 | 515 |
| 23 | ..... | 1,870 | 890 | 1,050 | 720 | 515 | 538 |
| 24 | ..... | 1,790 | 940 | 1,050 | 790 | 515 | 515 |
| 25 | 560 | 1,640 | 940 | 995 | 740 | 538 | 493 |
| 26 | 431 | 1,500 | 940 | 940 | 740 | 515 | 493 |
| 27 | 790 | 1,640 | 1,050 | 995 | 740 | 538 | 472 |
| 28 | 1,050 | 1,300 | 995 | 995 | 740 | 515 | 451 |
| 29 | 1,050 | 1,430 | 1,050 | 940 | 740 | 515 | 431 |
| 30 | 1,170 | 1,300 | 1,050 | 940 | 695 | 538 | 412 |
| 31 | 2,040 | ..... | 1,110 | ..... | 650 | 598 | ..... |

*Monthly discharge of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1920.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| March 25-31 | 2,040 | 431 | 1,010 |
| April | 3,700 | 1,300 | 2,360 |
| May | 1,300 | 840 | 1,020 |
| June | 3,000 | 940 | 1,360 |
| July | 940 | 560 | 761 |
| August | 695 | 290 | 532 |
| September | 560 | 412 | 499 |

### RED LAKE RIVER AT CROOKSTON, MINN.

LOCATION.—In sec. 30, T. 150 N., R. 46 W., at new Sampson's Addition highway bridge in Crookston, Polk County, a quarter of a mile below dam and power house of Crookston Light, Water & Power Co.'s plant. No tributaries enter for several miles.

DRAINAGE AREA.—5,320 square miles.

RECORDS AVAILABLE.—May 19, 1901, to September 30, 1920.

GAGE.—Barrett & Lawrence water-stage recorder, on right abutment of bridge; installed in September, 1911, replacing chain gage attached to bridge July 1, 1909. Both gages at same datum. During 1920 the water-stage recorder was not operating and the chain gage was used. Prior to July 1, 1909, gage was on old Sampson's Addition bridge, about 300 feet farther upstream; this gage read the same as present one at ordinary stages. Observer in 1919, S. V. Holder; in 1920, M. J. Dean.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge to which gage is attached.

CHANNEL AND CONTROL.—One channel at all stages. Bed composed of silt, gravel, and small boulders; slightly shifting. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 21.1 feet July 5 (discharge, about 14,700 second-feet); minimum open-water stage from water-stage recorder, 2.5 feet October 10 and 16 (discharge, 88 second-feet).

Maximum open-water stage recorded during year ending September 30, 1920, 10.8 feet April 16 (discharge, 5,230 second-feet); maximum discharge estimated 10,100 second-feet March 25 (stage-discharge relation affected by ice); minimum stage recorded, 3.4 feet September 3 (discharge, 358 second-feet). Records fragmentary for this year and probably the true maximum and minimum were missed.

1901–1920: Maximum open-water stage recorded during period, 21.1 feet July 5, 1919 (discharge, about 14,700 second-feet); minimum discharge recorded, 10 second-feet by current-meter measurement made January 27, 1912. The flow is controlled to such an extent that the minimum recorded discharge has no bearing on the minimum natural flow.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Considerable diurnal fluctuation at the gage is caused by operation of power plant immediately above station. The plant has little storage, so that the mean monthly flow should represent nearly the natural flow.

ACCURACY.—Stage-discharge relation practically permanent. One rating curve used during 1919 and 1920; well defined at all stages. Operation of water-stage recorder fairly satisfactory during 1919; not operating during 1920, and chain gage was read to tenths once daily. Daily discharge during 1919, ascertained by applying to rating table mean daily gage height obtained by planimetering the water-stage recorder graph, and during 1920 by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records during 1919, excellent; other records, fair.

*Discharge measurements of Red Lake River at Crookston, Minn., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| May 3 | J. T. Greenberg | 4.33 | 755 | Jan. 5 | H. A. Noble | [a] 5.32 | 416 |
| July 7 | E. F. Chandler | 18.10 | 10,700 | Mar. 26 | Chandler and Noble | [a] 21.07 | 8,500 |
| Sept. 10 | .....do | 4.36 | 752 | May 8 | W. L. Stockwell | 6.90 | 1,320 |
| 10 | .....do | 4.44 | 812 | 14 | .....do | 6.07 | 1,620 |
| | | | | June 25 | E. F. Chandler | 5.64 | 1,380 |
| | | | | Aug. 17 | .....do | 3.95 | 569 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Jan. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | |
| 1 | 302 | ..... | ..... | 2,480 | 850 | 622 | 1,500 | 1,950 | 1,040 |
| 2 | 267 | ..... | ..... | 2,760 | 760 | 629 | 2,000 | 1,950 | 1,040 |
| 3 | 244 | ..... | ..... | 2,690 | 760 | 635 | 7,820 | 1,820 | 1,040 |
| 4 | 222 | ..... | ..... | 2,550 | 715 | 675 | 12,500 | 1,760 | 1,040 |
| 5 | 200 | ..... | ..... | 2,480 | 850 | 715 | 14,400 | 1,760 | 970 |
| 6 | 178 | ..... | ..... | 2,020 | 1,040 | 805 | 13,600 | 1,760 | 900 |
| 7 | 156 | ..... | ..... | 1,820 | 1,140 | 850 | 11,300 | 1,760 | 825 |
| 8 | 134 | ..... | ..... | 1,760 | 1,200 | 1,040 | 9,530 | 1,760 | 750 |
| 9 | 112 | ..... | ..... | 1,620 | 1,200 | 1,200 | 8,630 | 1,810 | 675 |
| 10 | 88 | ..... | ..... | 1,380 | 1,200 | 1,140 | 8,000 | 1,860 | 600 |
| 11 | 129 | ..... | ..... | 1,620 | 1,260 | 1,090 | 7,460 | 1,920 | 525 |
| 12 | 120 | ..... | ..... | 1,760 | 1,140 | 1,040 | 7,100 | 1,970 | 450 |
| 13 | 108 | ..... | ..... | 1,880 | 1,140 | 1,000 | 6,680 | 2,020 | 375 |
| 14 | 122 | ..... | ..... | 1,820 | 1,140 | 950 | 6,500 | 3,200 | 284 |
| 15 | 103 | ..... | ..... | 1,500 | 1,040 | 900 | 6,420 | 3,430 | 277 |
| 16 | 88 | ..... | ..... | 1,260 | 990 | 850 | 6,160 | 3,280 | 288 |
| 17 | 106 | ..... | ..... | 1,200 | 1,040 | 760 | 5,820 | 3,200 | 313 |
| 18 | 122 | ..... | ..... | 1,040 | 990 | 760 | 5,400 | 3,130 | 264 |
| 19 | 115 | ..... | ..... | 990 | 990 | 760 | 4,890 | 2,980 | 320 |
| 20 | 127 | ..... | ..... | 850 | 940 | 715 | 4,390 | 2,760 | 306 |
| 21 | 182 | ..... | ..... | 805 | 895 | 750 | 3,990 | 2,550 | 298 |
| 22 | 224 | ..... | ..... | 850 | 850 | 800 | 3,590 | 2,340 | 320 |
| 23 | 234 | ..... | ..... | 895 | 850 | 850 | 3,280 | 2,020 | 313 |
| 24 | 270 | ..... | ..... | 895 | 805 | 900 | 2,980 | 1,760 | 300 |
| 25 | 270 | ..... | 850 | 850 | 760 | 950 | 2,620 | 1,560 | 290 |
| 26 | 280 | ..... | 1,260 | 850 | 715 | 1,000 | 2,480 | 1,380 | 277 |
| 27 | 280 | ..... | 1,690 | 805 | 675 | 1,100 | 2,410 | 1,260 | 281 |
| 28 | 280 | ..... | 1,880 | 805 | 595 | 1,200 | 2,280 | 1,140 | 291 |
| 29 | 290 | ..... | 2,280 | 850 | 601 | 1,300 | 2,140 | 1,140 | 277 |
| 30 | 290 | ..... | 2,690 | 895 | 608 | 1,400 | 2,020 | 1,090 | 240 |
| 31 | 290 | ..... | 2,620 | ..... | 615 | ..... | 1,950 | 1,040 | ..... |
| 1920. | | | | | | | | | |
| 1 | ..... | ..... | ..... | 5,400 | 2,280 | ..... | ..... | ..... | 595 |
| 2 | ..... | ..... | ..... | 5,740 | ..... | ..... | ..... | ..... | 595 |
| 3 | ..... | ..... | ..... | 4,800 | 1,880 | ..... | ..... | ..... | 358 |
| 4 | ..... | ..... | ..... | 2,760 | 2,020 | ..... | ..... | ..... | 436 |
| 5 | ..... | 436 | ..... | 2,480 | ..... | ..... | ..... | ..... | 495 |
| 6 | ..... | ..... | ..... | 4,390 | ..... | ..... | ..... | ..... | 515 |
| 7 | ..... | ..... | ..... | 4,550 | ..... | ..... | ..... | ..... | 515 |
| 8 | ..... | ..... | ..... | 4,230 | 2,210 | ..... | ..... | ..... | 555 |
| 9 | ..... | ..... | ..... | 4,230 | ..... | ..... | ..... | ..... | 535 |
| 10 | ..... | ..... | ..... | 4,800 | ..... | ..... | ..... | ..... | 595 |
| 11 | ..... | ..... | ..... | 4,070 | ..... | ..... | ..... | ..... | 595 |
| 12 | ..... | ..... | ..... | 4,720 | ..... | ..... | ..... | ..... | 575 |
| 13 | ..... | ..... | ..... | 4,800 | ..... | ..... | ..... | ..... | 535 |
| 14 | ..... | ..... | ..... | 4,720 | 1,690 | ..... | ..... | ..... | 416 |
| 15 | ..... | ..... | ..... | 4,890 | ..... | ..... | ..... | ..... | 455 |
| 16 | ..... | ..... | ..... | 5,230 | ..... | ..... | ..... | ..... | 495 |
| 17 | ..... | ..... | ..... | 4,920 | ..... | ..... | ..... | 595 | 535 |
| 18 | ..... | ..... | ..... | 4,620 | ..... | ..... | ..... | ..... | 515 |
| 19 | ..... | ..... | ..... | 4,310 | ..... | ..... | ..... | ..... | 515 |
| 20 | ..... | ..... | ..... | 3,910 | ..... | ..... | ..... | ..... | 555 |
| 21 | ..... | ..... | ..... | 3,590 | ..... | ..... | ..... | ..... | 535 |
| 22 | ..... | ..... | ..... | 3,750 | ..... | ..... | ..... | ..... | 595 |
| 23 | ..... | ..... | ..... | 3,910 | ..... | ..... | ..... | ..... | 595 |
| 24 | ..... | ..... | ..... | 2,550 | 1,880 | ..... | ..... | 715 | 675 |
| 25 | ..... | ..... | 10,100 | 3,120 | 1,820 | 1,380 | ..... | 760 | 595 |
| 26 | ..... | ..... | 9,080 | 2,900 | 1,760 | ..... | ..... | 595 | 595 |
| 27 | ..... | ..... | 8,330 | 2,550 | 1,820 | ..... | ..... | 595 | 595 |
| 28 | ..... | ..... | 7,580 | 2,690 | 1,380 | ..... | ..... | 595 | 575 |
| 29 | ..... | ..... | 6,820 | 2,410 | 1,260 | ..... | ..... | 595 | 555 |
| 30 | ..... | ..... | 6,070 | 2,550 | ..... | ..... | ..... | 595 | 595 |
| 31 | ..... | ..... | 5,320 | ..... | ..... | ..... | ..... | 595 | ..... |

NOTE.—No records obtained during winter except for periods Mar. 25–31, 1919, Jan. 5 and Mar. 25 to Apr. 9, 1920; discharge during these periods, ascertained by applying to rating table the daily gage height corrected for backwater from ice. Water-stage recorder not operating, and discharge estimated or interpolated, Oct. 3–9 and 25–31, 1918, May 29 to June 2, June 13–15, June 21 to July 2, Aug. 9–12, and Sept. 5–13, 24, 25, 1919. Chain gage not read, discharge interpolated, Mar. 27–30, and Apr. 17, 18, 22, 1920; the chain gage was not read during 1920, on days for which no daily discharge is given.

*Monthly discharge of Red Lake River at Crookston, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| 1918–19. | | | |
| October | 302 | 88 | 191 |
| March 25–31 | 2,690 | 850 | 1,900 |
| April | 2,760 | 805 | 1,470 |
| May | 1,260 | 595 | 915 |
| June | 1,400 | 622 | 913 |
| July | 14,400 | 1,500 | 5,800 |
| August | 3,430 | 1,040 | 2,040 |
| September | 1,040 | 240 | 506 |
| 1920. | | | |
| March 25–31 | 10,100 | 5,320 | 7,610 |
| April | 5,740 | 2,410 | 3,990 |
| August 24–31 | 760 | 595 | 631 |
| September | 675 | 358 | 543 |

## RED LAKE RIVER FLOOD OF JULY, 1919.

Unusual floods occurred on Red Lake River at and above the gaging station at Crookston, Minn., during the first week of July, 1919, as a result of heavy rainstorms that extended over the whole drainage area.

The precipitation occurred on July 1, 2, and 3, although at most points the storm did not continue more than 48 hours and had ended by the morning of July 3. The precipitation for the three days at each of the five United States Weather Bureau stations within the area ranged between 5.3 and 6.9 inches, and the total rainfall at each of the 13 nearest stations surrounding this area ranged for this period between 1.1 and 9 inches. From all these the isohyetal average for the drainage area of Red Lake River above Crookston during the three days is found to be 5.7 inches. The ensuing floods on the river and its tributaries much surpassed any ever recorded in the summer since stream-gaging work was begun, and are said to be higher than any open-water floods since the country was first settled by white men 40 or 50 years ago.

The drainage area of Red Lake River above the gaging station at Crookston, Minn., is 5,320 square miles. The gaging station is 30 miles above the mouth of the river, and the extreme low stage there is 2.2 feet. Continuous records during the flood were obtained, showing a rise from a stage of about 6 feet (discharge, 1,600 second-feet) on July 2 to a maximum height of 21.1 feet (discharge, 14,700 second-feet) on the afternoon of July 5; mean gage height for July 5, 20.8 feet. On July 6, 7, and 8 the mean gage height was 20, 17.6, and 15.7 feet, respectively. Thereafter the stage fell gradually to a height of 6.5 feet (discharge, 1,950 second-feet) at the end of July.

The gaging station at Crookston has been maintained since May 19, 1901, and since that date the maximum stage reached during the flood of 1919 has never been exceeded except on April 17, 1916, when a stage of 21.8 feet was recorded, and on March 25, 1920, when a gage height of 23.3 feet was reached. Before gage-height records were kept regularly, a height of 25.2 feet has been well authenticated for April 11 either of the year 1896 or 1897. On April 24, 1904, a gage height of 20.3 feet occurred, and on April 15, 1906, 21 feet was recorded. However, all of these stages occurred at the time of the ice break-up, when the velocity of flow is considerably retarded by floating and jammed ice; hence it is doubtless true that the discharge of July 5, 1919, was greater than any which has ever before occurred within a 40-year period.

At Huot Bridge, 15 miles above Crookston, the highest stage since 1875 and prior to 1920 occurred during the spring break-up of 1896 or 1897, at which time the high-

water elevation was permanently marked by residents; this high stage was in part caused by ice jams. But on March 24, 1920, an ice jam (after the breaking of which the water fell 6 feet in less than 12 hours) raised the water level about 2 feet above the high-water mark of 1896–97. The stage of July 4 or 5, 1919, was said by residents to be next highest to the 1896–97 stage, it being 3.3 feet lower.

The only important tributaries of Red Lake River are Black, Clearwater, and Thief rivers. Black River enters about 23 miles, by river, above Crookston, and drains about 200 square miles. No record of its flow was obtained, but it is not thought to have been an important contributor to the flood.

The chief tributary is Clearwater River, which drains 1,310 square miles, and enters Red Lake River at Red Lake Falls, 25 miles above Crookston. A gaging station on Clearwater River was maintained at Red Lake Falls from 1909 to 1917. The extreme low stage is 1.6 feet. The rise at this station began at noon July 2, and on the afternoon of July 3 the maximum gage height, 9.7 feet (discharge, 6,700 second-feet), was reached. From this height there was a gradual fall to a stage of 6.9 feet at noon July 7, and to 6.5 feet on the morning of July 8. Previous flood heights recorded are, 15 feet April 6, 1913, and 8.9 feet April 12, 1916, both of which are known to have occurred during the spring break-up, and are supposed to have been chiefly the result of ice jams reported by the observer at these times. Therefore the discharge of July 3, 1919, is assumed to be the greatest on record.

Thief River enters Red Lake River at Thief River Falls, 50 miles above Crookston. A gaging station was maintained 4 miles above its mouth from 1909 to 1917, at which point the drainage area is 1,010 square miles. The extreme natural low stage at the station is 3.6 feet (discharge, about 1 second-foot). No daily records during the flood of 1919 were obtainable, but the stage of the river was found by a hydrographer, on the afternoon of July 8, to be at gage height 14.5 feet (discharge, 4,100 second-feet) and still rising slowly, but apparently near its maximum. From information obtained from the former gage reader, when the station was reestablished on April 1, 1920, it was ascertained that the river rose to a crest stage of about 16.3 feet (discharge, 4,900 second-feet) on or about July 10. A gage height of 14.5 feet, was reached on April 23, 1916. On April 7, 1913, the stage of the river rose to 14 feet, but this was caused in part by ice jams. No other recorded gage height approaches the height for July, 1919. The flood flow of Thief River was delayed at least four days, presumably in former lake basins, now drained, and hence reached the lower Red Lake River so long after the crest of the main flood that its damaging effect was practically negligible.

A station was maintained from 1909 to 1918 on Red Lake River at Thief River Falls, below the entrance of Thief River; total drainage area, 3,430 square miles. The natural minimum stage there is 2.8 feet (discharge, 7 second-feet). Gage readings were obtained for several days during the flood of 1919. During the night of July 2 there was an abrupt rise, to a gage height of 11.1 feet on the morning of July 3. On the morning of July 4 the gage height was 12.6 feet, the maximum, 12.7 feet (discharge, 7,600 second-feet), occurring in the afternoon. On the morning of July 5 the stage was 12.5 feet, from which there was a gradual fall to 11.2 feet on the morning of July 8. The maximum stage recorded at this station is 15 feet April 16, 1916 (discharge, 10,600 second-feet). No other heights above 10 feet have occurred at this station while it has been maintained, except on April 6, 1916 (10.8 feet), and on April 10, 1917 (10.6 feet), both of which occurred during the spring break-up; hence the maximum discharge of the flood of July, 1919, was much greater than any other except that of April, 1916.

From the observed gage heights at Crookston for the week of highest stage, July 4 to 10, inclusive, the total run-off for the seven days is found to be 145,000 acre-feet. This is, however, a total of only 0.5 inch per square mile of drainage area, which illus-

trates how small a fraction of rainfall flows immediately off from level, undrained, or imperfectly drained swampy land such as this river flows through.

If it be assumed that the time of flow to Crookston from Red Lake Falls was about 24 hours, and from Thief River Falls about 36 hours, the partial gage-height record at each of these points would indicate that about 55,000 acre-feet was contributed by Clearwater River, which is 0.8 inch per square mile of drainage area. About 80,000 acre-feet reached Crookston from Thief River Falls during the week of highest stage, of which an estimated amount of 25,000 acre-feet was contributed by Thief River, although this estimate is doubtful on account of lack of continuous gage readings on Thief River.

This flood caused no loss of life, although at Crookston much inconvenience and considerable injury resulted. It caused a very great loss to agricultural and grazing lands by overflow. The streams overflowed their banks at low places, submerging the crops long enough to cause total loss, and covering the vegetation in pasture lands with slime and mud so as to destroy all grazing that summer. However, the area injured by overflow from the rivers was very small as compared with that which suffered by the collecting of water on the lower fields from other fields a few inches or feet higher. On account of the small slope of the country and the infrequency of drainage ditches the water remained on the land several days, and destroyed its usefulness for that season.

### THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 3, T. 154 N., R. 43 W., 1,000 feet above steel highway bridge, in Marshall County, 5 miles north of Thief River Falls, Pennington County, and 5 miles above mouth of Thief River.

DRAINAGE AREA.—1,010 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1917, and April 1 to September 30, 1920.

GAGE.—Chain gage installed August 19, 1920, on cantilever timber fastened to a tree on right bank; read by Byron Yager. During period April 2 to August 18, 1920, high stages prevented the installation of the chain gage and a series of temporary gages was used. An auxiliary staff gage is attached to left abutment of highway bridge, 1,000 feet below chain gage.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge 1,000 feet below gage or by wading near gage.

CHANNEL AND CONTROL.—One channel at all stages. Bed composed of heavy gravel and boulders; practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum discharge estimated, 1,780 second-feet April 8 (stage-discharge relation affected by ice); minimum stage, 3.6 feet September 10, 11, and 19–21 (discharge, 0.4 second-foot).

1909–1917; 1920: Maximum stage recorded, 14.5 feet April 23, 1916 (discharge, 4,080 second-feet); practically no flow past the gage October 1, 1910, to March 12, 1911, August 2–13, 22–26, 1911, September 1–3, 5–12, 14–18, 1911, and November 10, 1911, to March 26, 1912.

Flood of July, 1919, reached a stage of about 16.3 feet (discharge, about 4,900 second-feet).

REGULATION.—Dam at Thief River Falls, three-quarters of a mile below mouth of Thief River, backs up the water in Thief River for several miles, but the station is protected from influence of dam by rapids below.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 3,800 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period April 1–9, when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table the daily gage height corrected for backwater from ice, and except for period April 25–26, for which it was interpolated on account of lack of gage readings. Open-water records excellent; winter records fair.

COOPERATION.—Station maintained in cooperation with the Department of Drainage and Waters, E. V. Willard, commissioner.

*Discharge measurements of Thief River near Thief River Falls, Minn., during the year ending Sept. 30, 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Apr. 27 | H. A. Noble | 6.06 | 399 | June 10 | G. L. Smith | 8.93 | 1,390 |
| May 28 | G. L. Smith | 5.59 | 266 | 15 | do | 7.13 | 639 |
| June 4 | do | 5.85 | 336 | Aug. 19 | Chandler and Smith | 3.86 | 2.6 |

*Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 800 | 213 | 275 | 54 | 15 | 0.8 | 16 | 1,460 | 61 | 440 | 33 | 4 | 0.8 |
| 2 | 1,000 | 186 | 334 | 51 | 13 | .8 | 17 | 1,200 | 56 | 330 | 29 | 3 | .8 |
| 3 | 1,230 | 181 | 349 | 42 | 12 | .8 | 18 | 878 | 54 | 232 | 29 | 3 | .6 |
| 4 | 1,310 | 155 | 319 | 37 | 12 | .8 | 19 | 612 | 70 | 142 | 26 | 3 | .4 |
| 5 | 1,340 | 150 | 275 | 33 | 8 | .8 | 20 | 548 | 77 | 118 | 26 | 4 | .4 |
| 6 | 1,460 | 131 | 218 | 33 | 7 | .8 | 21 | 580 | 86 | 96 | 23 | 4 | .4 |
| 7 | 1,700 | 131 | 194 | 33 | 6 | .6 | 22 | 580 | 90 | 84 | 20 | 4 | .4 |
| 8 | 1,780 | 107 | 275 | 29 | 6 | .6 | 23 | 612 | 142 | 107 | 40 | 3 | .8 |
| 9 | 1,500 | 107 | 743 | 23 | 5 | .6 | 24 | 517 | 260 | 103 | 77 | 3 | .8 |
| 10 | 1,120 | 103 | 1,160 | 23 | 4 | .4 | 25 | 471 | 260 | 86 | 77 | 2 | 2 |
| 11 | 1,020 | 96 | 1,230 | 23 | 4 | .4 | 26 | 425 | 275 | 77 | 69 | 2 | 1.6 |
| 12 | 1,090 | 90 | 1,200 | 26 | 8 | .6 | 27 | 379 | 275 | 77 | 65 | 1.4 | 2 |
| 13 | 1,160 | 84 | 1,020 | 34 | 8 | .6 | 28 | 319 | 260 | 72 | 40 | .8 | 2 |
| 14 | 1,310 | 72 | 743 | 34 | 6 | .6 | 29 | 304 | 246 | 65 | 29 | .8 | 1.6 |
| 15 | 1,380 | 65 | 548 | 33 | 6 | .6 | 30 | 260 | 232 | 61 | 20 | .8 | 1.6 |
| | | | | | | | 31 | ..... | 246 | ..... | 17 | .8 | ..... |

*Monthly discharge of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1920.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| April | 1,780 | 260 | 945 |
| May | 275 | 54 | 147 |
| June | 1,230 | 61 | 366 |
| July | 77 | 17 | 36.4 |
| August | 15 | .8 | 5.15 |
| September | 2 | .4 | .87 |
| The period | 1,780 | .4 | 247 |

### PEMBINA RIVER AT NECHE, N. DAK.

LOCATION.—At Great Northern Railway bridge a third of a mile above Great Northern Railway dam and two-thirds of a mile north of Neche, in Pembina County.

DRAINAGE AREA.—2,960 square miles (revised).

RECORDS AVAILABLE.—May 1, 1903, to September 30, 1915, and April 1, 1919, to September 30, 1920.

GAGE.—Vertical staff bolted to concrete abutment at north end of railway bridge; read by P. J. Horgan.

DISCHARGE MEASUREMENTS.—Made from highway bridge 350 feet below railway bridge; at very low stages made by wading below Great Northern dam.

CHANNEL AND CONTROL.—Bed composed of clay and silt. Control is loose-rock dam, a third of a mile below gage; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 18.3 feet April 8 (stage-discharge relation affected by ice); maximum open-water stage, 15.1 feet April 15 (discharge, 2,430 second-feet); minimum discharge, estimated 4 second-feet April 1 and 2, because of ice.

Maximum discharge during year ending September 30, 1920, estimated 361 second-feet April 19 and 20 (stage-discharge relation affected by ice); minimum stage recorded, 3.5 feet August 24 to September 20 (discharge, 10 second-feet).

1903–1915; 1919 and 1920: Maximum discharge recorded, 3,870 second-feet May 2, 1904 (gage height, 20.9 feet); a stage of 21.4 feet (discharge, 3,850 second-feet) was reached April 8, 1913; minimum stage recorded, 1.3 feet September 15, 16, 18, 19, and 21–24, 1911 (discharge, 1.0 second-foot).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The water is raised at low stages from 1 to 2 feet at the gage by the loose rock dam about 3 feet high, a third of a mile below, constructed to give sufficient depth of water for the intake of Great Northern Railway water tank. There is considerable leakage through the dam, but no permanent determination of the effect of the dam can be made because it is liable to be somewhat disturbed at its crest by ice run or spring floods in any year. There are no reservoirs or power plants that affect the flow.

ACCURACY.—Stage-discharge relation changed slightly during winter of 1919–20. Rating curves used during periods April 1 to November 30, 1919, and March 26 to September 30, 1920, both well defined between 10 and 4,000 second-feet; curve used during the latter period is a revision below 425 second-feet of curve used during former period. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records good; winter records poor.

*Discharge measurements of Pembina River at Neche, N. Dak., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Mar. 31 | H. A. Noble | 4.30 | a 4 | May 6 | W. L. Stockwell | 5.22 | 346 |
| May 2 | ....do | 5.95 | 447 | June 28 | E. F. Chandler | 4.41 | 111 |
| 30 | J. T. Greenberg | 5.36 | 283 | Sept. 8 | ....do | 3.48 | 9.5 |
| 31 | ....do | 5.39 | 287 | 9 | ....do | 3.49 | 9.0 |
| Aug. 14 | E. F. Chandler | 3.99 | 25 | | | | |

a Stage-discharge relation affected by ice; discharge estimated.

*Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|
| 1919. | | | | | | |
| 1 | 4 | 380 | 290 | 110 | 41 | 27 |
| 2 | 4 | 380 | 268 | 92 | 41 | 27 |
| 3 | 12 | 380 | 268 | 92 | 41 | 27 |
| 4 | 491 | 380 | 247 | 92 | 41 | 27 |
| 5 | 645 | 380 | 247 | 92 | 41 | 27 |
| 6 | 1,200 | 380 | 205 | 92 | 41 | 27 |
| 7 | 1,460 | 402 | 205 | 92 | 27 | 18 |
| 8 | 1,810 | 425 | 185 | 92 | 27 | 18 |
| 9 | 1,960 | 469 | 185 | 92 | 27 | 18 |
| 10 | 1,500 | 469 | 165 | 92 | 27 | 18 |
| 11 | 1,060 | 447 | 165 | 92 | 27 | 18 |
| 12 | 975 | 380 | 165 | 92 | 27 | 18 |
| 13 | 1,080 | 380 | 165 | 92 | 27 | 18 |
| 14 | 1,860 | 380 | 165 | 92 | 27 | 27 |
| 15 | 2,430 | 380 | 146 | 92 | 27 | 27 |
| 16 | 1,640 | 380 | 146 | 110 | 27 | 27 |
| 17 | 909 | 380 | 128 | 110 | 27 | 27 |
| 18 | 645 | 380 | 128 | 110 | 27 | 27 |
| 19 | 535 | 402 | 128 | 110 | 27 | 27 |
| 20 | 491 | 402 | 146 | 110 | 27 | 27 |
| 21 | 447 | 380 | 146 | 92 | 27 | 41 |
| 22 | 425 | 380 | 128 | 92 | 27 | 41 |
| 23 | 380 | 357 | 110 | 74 | 27 | 41 |
| 24 | 380 | 357 | 110 | 74 | 27 | 57 |
| 25 | 380 | 357 | 110 | 74 | 27 | 57 |
| 26 | 380 | 335 | 110 | 74 | 27 | 57 |
| 27 | 380 | 335 | 110 | 74 | 27 | 57 |
| 28 | 380 | 312 | 110 | 57 | 27 | 57 |
| 29 | 380 | 312 | 128 | 57 | 27 | 74 |
| 30 | 380 | 312 | 110 | 41 | 27 | 74 |
| 31 | ..... | 290 | ..... | 41 | 27 | ..... |

| Day. | Oct. | Nov. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | |
| 1 | 74 | 74 | ..... | 201 | 280 | 182 | 95 | 38 | 10 |
| 2 | 74 | ..... | ..... | 182 | 280 | 182 | 95 | 38 | 10 |
| 3 | 74 | ..... | ..... | 129 | 280 | 182 | 95 | 27 | 10 |
| 4 | 74 | ..... | ..... | 79 | 280 | 182 | 95 | 27 | 10 |
| 5 | 92 | ..... | ..... | 50 | 280 | 182 | 95 | 27 | 10 |
| 6 | 92 | 57 | ..... | 50 | 260 | 182 | 95 | 27 | 10 |
| 7 | 92 | ..... | ..... | 50 | 260 | 182 | 95 | 27 | 10 |
| 8 | 92 | ..... | ..... | 50 | 260 | 182 | 95 | 19 | 10 |
| 9 | 92 | ..... | ..... | 50 | 240 | 182 | 95 | 19 | 10 |
| 10 | 92 | ..... | ..... | 50 | 240 | 182 | 95 | 19 | 10 |
| 11 | 92 | 57 | ..... | 50 | 240 | 182 | 95 | 19 | 10 |
| 12 | 92 | ..... | ..... | 50 | 240 | 182 | 95 | 19 | 10 |
| 13 | 92 | ..... | ..... | 50 | 220 | 164 | 79 | 19 | 10 |
| 14 | 92 | ..... | ..... | 50 | 220 | 164 | 79 | 19 | 10 |
| 15 | 92 | ..... | ..... | 50 | 220 | 146 | 79 | 19 | 10 |
| 16 | 92 | 57 | ..... | 112 | 220 | 146 | 79 | 13 | 10 |
| 17 | 92 | ..... | ..... | 280 | 220 | 129 | 79 | 13 | 10 |
| 18 | 92 | ..... | ..... | 300 | 220 | 129 | 79 | 13 | 10 |
| 19 | 92 | ..... | ..... | 361 | 201 | 129 | 79 | 13 | 10 |
| 20 | 92 | ..... | ..... | 361 | 201 | 129 | 79 | 13 | 10 |
| 21 | 92 | 57 | ..... | 280 | 201 | 129 | 79 | 13 | 13 |
| 22 | 92 | ..... | ..... | 260 | 201 | 129 | 79 | 13 | 19 |
| 23 | 92 | ..... | ..... | 240 | 201 | 129 | 79 | 13 | 27 |
| 24 | 92 | ..... | ..... | 240 | 201 | 112 | 79 | 10 | 27 |
| 25 | 92 | ..... | ..... | 300 | 201 | 112 | 50 | 10 | 38 |
| 26 | 92 | 74 | 10 | 300 | 201 | 112 | 50 | 10 | 38 |
| 27 | 92 | ..... | 10 | 300 | 201 | 112 | 38 | 10 | 38 |
| 28 | 92 | ..... | 10 | 300 | 201 | 112 | 38 | 10 | 50 |
| 29 | 92 | 74 | 10 | 300 | 201 | 95 | 38 | 16 | 50 |
| 30 | 74 | ..... | 260 | 280 | 201 | 95 | 38 | 10 | 50 |
| 31 | 74 | ..... | 300 | ..... | 201 | ..... | 38 | 10 | ..... |

NOTE.—Stage-discharge relation affected by ice Apr. 1–9, Oct. 30 to Nov. 29, 1919, and Mar. 26 to Apr. 24, 1920; discharge ascertained by applying to rating table the daily gage height corrected for backwater from ice. Discharge estimated Oct. 1–4, 1919, on account of lack of gage readings. Gage not read on days during November, 1919, for which no discharge is given. No gage-height record obtained from Nov. 30, 1919, to Mar. 25, 1920.

*Monthly discharge of Pembina River at Neche, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1919. | | | | |
| April | 2,430 | 4 | 821 | 48,900 |
| May | 469 | 290 | 377 | 23,200 |
| June | 290 | 110 | 164 | 9,760 |
| July | 110 | 41 | 87.0 | 5,350 |
| August | 41 | 27 | 29.7 | 1,830 |
| September | 74 | 18 | 34.4 | 2,050 |
| The period | | | | 91,100 |
| 1919-20. | | | | |
| October | 92 | 74 | 88.5 | 5,440 |
| November | | | a 65.0 | 3,870 |
| March | 300 | | a 28.0 | 1,720 |
| April | 361 | 50 | 178 | 10,600 |
| May | 280 | 201 | 228 | 14,000 |
| June | 182 | 95 | 149 | 8,870 |
| July | 95 | 38 | 76.7 | 4,720 |
| August | 38 | 10 | 17.6 | 1,080 |
| September | 50 | 10 | 18.3 | 1,090 |

a Estimated.

### ROSEAU RIVER AT CARIBOU, MINN.

LOCATION.—In sec. 34, T. 164 N., R. 45 W., at steel highway bridge in Caribou, Kittson County, 1 mile south of international boundary and 3 miles upstream from crossing of boundary line by river.

DRAINAGE AREA.—1,340 square miles.

RECORDS AVAILABLE.—April 1 to October 6, 1917; April 12 to September 30, 1920.

GAGE.—Chain gage fastened to downstream handrail of bridge, 60 feet from left abutment; read by James A. McKibbin.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel is artificial, of trapezoidal cross-section, about 100 feet wide and 10 feet deep. Bed composed of hardpan, with few scattered large boulders. Point of zero flow, bottom of channel, gage height about 3.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 11.5 feet April 15 (discharge, estimated 1,600 second-feet, because of ice); minimum stage, 3.15 feet August 23 to September 1 and September 8–14 (discharge, 12 second-feet)

1917 and 1920: Maximum stage recorded same as for 1920; minimum stage, 3.15 feet September 10–12, 29, and 30, 1917 (discharge, about 4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—No diversions involving storage or loss of water. A small channel about 3½ miles long was dredged some years ago from a point about 4 miles above the station to a point 1 mile below. At stage of about 6.0 feet water flows in this channel and must be measured and included in all measurements of the main channel.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve, based on 7 discharge measurements and on computations using Kutter's formula, is fairly well defined throughout. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to table of daily discharge. Records good.

COOPERATION.—Station maintained in cooperation with the Department of Drainage and Waters, E. V. Willard, commissioner.

*Discharge measurements of Roseau River at Caribou, Minn., during the year ending Sept. 30, 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1920. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Apr. 26 | H. A. Noble | 7.08 | [a] 685 | June 24 | E. F. Chandler | 4.49 | 150 |
| May 15 | W. L. Stockwell | 5.25 | 261 | Aug. 18 | do | 3.18 | 14.6 |
| June 12 | do | 6.59 | [b] 527 | | | | |

[a] Includes 48 second-feet measured in cut-off ditch.
[b] Includes 21 second-feet measured in cut-off ditch.

*Daily discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 600 | 649 | 88 | 16 | 12 | 16 | 1,120 | 252 | 422 | 27 | 14 | 14 |
| 2 | ..... | 576 | 649 | 76 | 16 | 14 | 17 | 1,090 | 219 | 362 | 24 | 14 | 14 |
| 3 | ..... | 530 | 674 | 70 | 16 | 14 | 18 | 865 | 211 | 508 | 24 | 14 | 16 |
| 4 | ..... | 464 | 700 | 64 | 16 | 14 | 19 | 700 | 211 | 443 | 24 | 14 | 18 |
| 5 | ..... | 443 | 700 | 59 | 16 | 14 | 20 | 624 | 235 | 287 | 24 | 14 | 18 |
| 6 | ..... | 402 | 649 | 54 | 16 | 14 | 21 | 576 | 252 | 188 | 24 | 14 | 16 |
| 7 | ..... | 402 | 649 | 48 | 16 | 14 | 22 | 576 | 252 | 159 | 24 | 14 | 16 |
| 8 | ..... | 382 | 649 | 43 | 16 | 12 | 23 | 624 | 252 | 132 | 24 | 12 | 19 |
| 9 | ..... | 362 | 624 | 43 | 16 | 12 | 24 | 624 | 305 | 132 | 24 | 12 | 24 |
| 10 | ..... | 362 | 576 | 39 | 16 | 12 | 25 | 624 | 324 | 119 | 23 | 12 | 24 |
| 11 | ..... | 343 | 553 | 35 | 14 | 12 | 26 | 624 | 486 | 106 | 21 | 12 | 27 |
| 12 | 753 | 324 | 530 | 35 | 14 | 12 | 27 | 624 | 530 | 112 | 18 | 12 | 31 |
| 13 | 1,020 | 287 | 530 | 30 | 14 | 12 | 28 | 649 | 553 | 112 | 18 | 12 | 39 |
| 14 | 1,160 | 287 | 530 | 24 | 14 | 12 | 29 | 624 | 624 | 106 | 18 | 12 | 35 |
| 15 | 1,600 | 252 | 486 | 27 | 14 | 14 | 30 | 624 | 624 | 94 | 18 | 12 | 31 |
| | | | | | | | 31 | ..... | 624 | ..... | 18 | 12 | ..... |

NOTE.—Stage-discharge relation affected by ice Apr. 12-16: discharge ascertained by applying to rating table the daily gage height corrected for backwater from ice. Gage not read April 26; discharge interpolated.

*Monthly discharge of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1920.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| April 12-30 | 1,600 | ..... | 795 |
| May | 600 | 211 | 386 |
| June | 700 | 94 | 414 |
| July | 88 | 18 | 35.1 |
| August | 16 | 12 | 14.0 |
| September | 39 | 12 | 17.8 |

### MOUSE RIVER AT MINOT, N. DAK.

LOCATION.—At Anne Street footbridge, northeast of Great Northern Railway roundhouse at Minot, in Ward County.

DRAINAGE AREA.—8,400 square miles.

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1920.

GAGE.—Temporary vertical staff gage on shore of river, 500 feet above Anne Street footbridge; installed by observer about April 1, 1919, when old Anne Street bridge was taken down and the staff gage on that bridge was destroyed; used October 1, 1918, to September 30, 1920. About March 10, 1920, a new vertical staff gage in two sections was installed on the piers of the new Anne Street bridge, but was read only once a week, the temporary gage being used through remainder of year. Gages read by Ephraim Cox. From 1903 until December, 1909, gage was a vertical staff located on a footbridge then existing about 20 rods above Anne Street. All gages referred to same datum.

DISCHARGE MEASUREMENTS.—Made from Anne Street bridge, North Street bridge, South Sixth Street bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of clay and silt; practically permanent. Control is timber and loose-rock dam 1 mile below gage at water tank of Minneapolis, St. Paul & Sault Ste. Marie Railway. Dam is submerged at high stages, causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.0 feet April 18–20 (discharge, 1,860 second-feet); minimum stage, 3.95 feet August 26–28 and September 1–3, 9, and 21-23 (discharge, 0.7 second-foot).

Maximum stage recorded during year ending September 30, 1920, 17.1 feet May 5 and 6 (discharge, 2,560 second-feet); minimum stage, 3.7 feet February 29 and March 6 (discharge, 0.4 second-foot).

1903–1920: Maximum stage recorded during period, 21.9 feet April 20, 1904 (discharge, estimated 12,000 second-feet); minimum stage, 1.8 feet February 28, 1913 (discharge, 0.1 second-foot).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Dam about 5 feet high at Minneapolis, St. Paul & Sault Ste. Marie Railway tank, a mile below, raises water at gage about 5 feet at ordinary low stage. The dam being designed merely to give enough depth of water for the intake-pipe suction, has no sluices, but is not absolutely tight. When discharge is less than about 6 second-feet, the water level falls below crest of dam.

DIVERSIONS.—None.

ACCURACY.—Stage-discharge relation changed slightly during latter part of 1918; affected by ice during winters of 1919 and 1920; otherwise permanent. Two rating curves used, both well defined below 2,500 second-feet; applicable respectively, October 1 to November 30, 1918, and December 1, 1918, to September 30, 1920; curve used during latter period is a slight revision at the low-water end of curve used during former period. Gage read to half-tenths once daily during open-water periods, and to half-tenths once a week during ice-affected periods. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records fair; winter records poor.

*Discharge measurements of Mouse River at Minot, N. Dak., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Discharge. | Gage height. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Apr. 12[a] | H. A. Noble | 11.98 | 1,340 | May 3[d] | E. F. Chandler | 16.66 | 2,120 |
| May 30[b] | do | 5.09 | 50 | June 21[d] | do | 5.33 | 56 |
| July 2 | E. F. Chandler | 4.57 | 9.2 | Aug. 27 | do | 4.49 | 9.3 |
| Aug 30[c] | do | 3.96 | .7 | | | | |

[a] Measurement made from Anne Street bridge.
[b] Measurement made from Ninth Street bridge.
[c] Measurement made with float.
[d] Measurement made from South Sixth Street bridge.

*Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | ..... | ..... | ..... | ..... | 17 | 2.4 | 155 | 469 | 50 | 17 | 4 | 0.7 |
| 2 | ..... | 16 | ..... | ..... | ..... | ..... | 335 | 390 | 44 | 11 | 4 | .7 |
| 3 | ..... | ..... | ..... | ..... | ..... | ..... | 730 | 362 | 50 | 11 | 4 | .7 |
| 4 | ..... | ..... | ..... | 11 | ..... | ..... | 1,010 | 335 | 50 | 17 | 4 | .8 |
| 5 | 11 | ..... | ..... | ..... | ..... | ..... | 1,350 | 362 | 44 | 25 | 3.2 | .8 |
| 6 | ..... | ..... | ..... | ..... | ..... | ..... | 1,480 | 362 | 39 | 21 | 4 | .8 |
| 7 | ..... | ..... | 17 | ..... | ..... | ..... | 1,460 | 296 | 34 | 21 | 4 | .8 |
| 8 | ..... | ..... | ..... | ..... | 7 | 4 | 1,290 | 272 | 30 | 17 | 3.2 | .8 |
| 9 | ..... | 23 | ..... | ..... | ..... | ..... | 862 | 237 | 25 | 14 | 3.2 | .7 |
| 10 | ..... | ..... | ..... | ..... | ..... | ..... | 826 | 204 | 25 | 14 | 3.2 | 1.0 |
| 11 | ..... | ..... | ..... | 11 | ..... | ..... | 960 | 215 | 21 | 11 | 3.2 | 1.0 |
| 12 | 16 | ..... | ..... | ..... | ..... | ..... | 1,170 | 226 | 21 | 11 | 2.4 | 1.0 |
| 13 | ..... | ..... | ..... | ..... | ..... | ..... | 1,440 | 226 | 25 | 9 | 2.4 | .8 |
| 14 | ..... | ..... | 25 | ..... | ..... | ..... | 1,520 | 204 | 30 | 9 | 2.4 | .8 |
| 15 | ..... | ..... | ..... | ..... | 4 | 7 | 1,610 | 194 | 30 | 11 | 3.2 | .8 |
| 16 | ..... | 16 | ..... | ..... | ..... | ..... | 1,710 | 226 | 25 | 11 | 1.6 | .8 |
| 17 | ..... | ..... | ..... | ..... | ..... | ..... | 1,790 | 155 | 25 | 9 | 1.6 | .8 |
| 18 | ..... | ..... | ..... | 7 | ..... | ..... | 1,860 | 127 | 30 | 9 | 1.6 | 1.0 |
| 19 | 23 | ..... | ..... | ..... | ..... | ..... | 1,860 | 118 | 30 | 7 | 1.1 | 1.0 |
| 20 | ..... | ..... | ..... | ..... | ..... | ..... | 1,860 | 127 | 25 | 7 | 1.1 | 1.0 |
| 21 | ..... | ..... | 17 | ..... | ..... | ..... | 1,790 | 136 | 34 | 7 | 1.0 | .7 |
| 22 | ..... | ..... | ..... | ..... | 4 | 17 | 1,640 | 136 | 39 | 5.5 | 1.0 | .7 |
| 23 | ..... | 16 | ..... | ..... | ..... | 25 | 1,480 | 127 | 39 | 7 | 1.0 | .7 |
| 24 | ..... | ..... | ..... | ..... | ..... | 30 | 1,220 | 110 | 34 | 9 | .8 | .8 |
| 25 | ..... | ..... | ..... | 11 | ..... | 34 | 1,060 | 101 | 30 | 9 | .8 | .8 |
| 26 | 23 | ..... | ..... | ..... | ..... | 39 | 880 | 101 | 25 | 7 | .7 | .8 |
| 27 | ..... | ..... | ..... | ..... | ..... | 44 | 690 | 85 | 25 | 7 | .7 | .8 |
| 28 | ..... | ..... | 17 | ..... | ..... | 50 | 648 | 70 | 21 | 7 | .7 | .8 |
| 29 | ..... | ..... | ..... | ..... | ..... | 56 | 627 | 56 | 21 | 9 | .8 | .8 |
| 30 | ..... | 16 | ..... | ..... | ..... | 85 | 563 | 70 | 17 | 9 | .8 | .8 |
| 31 | ..... | ..... | ..... | ..... | ..... | 118 | ..... | 56 | ..... | 7 | .8 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | .6 | .6 | ..... | ..... | ..... | ..... | 606 | 2,050 | 194 | 56 | 17 | 4.0 |
| 2 | .7 | ..... | ..... | ..... | ..... | ..... | 585 | 2,210 | 184 | 35 | 14 | 4.0 |
| 3 | .7 | ..... | ..... | .6 | ..... | ..... | 563 | 2,390 | 194 | 70 | 14 | 4.0 |
| 4 | .7 | ..... | ..... | ..... | ..... | ..... | 517 | 2,510 | 184 | 56 | 14 | 4.0 |
| 5 | .7 | ..... | ..... | ..... | ..... | ..... | 390 | 2,560 | 184 | 56 | 11 | 4.0 |
| 6 | .7 | ..... | .5 | ..... | ..... | .4 | 260 | 2,560 | 174 | 44 | 11 | 7.0 |
| 7 | .7 | ..... | ..... | ..... | .6 | ..... | 101 | 2,510 | 194 | 39 | 11 | 7.0 |
| 8 | .7 | .8 | ..... | ..... | ..... | ..... | 56 | 2,470 | 164 | 39 | 11 | 7.0 |
| 9 | .6 | ..... | ..... | ..... | ..... | ..... | 34 | 2,390 | 155 | 44 | 9.0 | 4.0 |
| 10 | .6 | ..... | ..... | .6 | ..... | ..... | 25 | 2,240 | 174 | 44 | 9.0 | 4.0 |
| 11 | .6 | ..... | ..... | ..... | ..... | ..... | 44 | 2,060 | 155 | 34 | 9.0 | 4.0 |
| 12 | .6 | ..... | ..... | ..... | ..... | ..... | 118 | 1,840 | 136 | 34 | 7.0 | 4.0 |
| 13 | .6 | ..... | .5 | ..... | ..... | .5 | 155 | 1,630 | 127 | 44 | 4.0 | 2.4 |
| 14 | .6 | ..... | ..... | ..... | .5 | .6 | 362 | 1,240 | 127 | 39 | 7.0 | 2.4 |
| 15 | .6 | .8 | ..... | ..... | ..... | 2.4 | 418 | 992 | 118 | 39 | 7.0 | 2.4 |
| 16 | .6 | ..... | ..... | ..... | ..... | 1.6 | 493 | 826 | 118 | 34 | 7.0 | 4.0 |
| 17 | .6 | ..... | ..... | .5 | ..... | .8 | 669 | 690 | 127 | 30 | 4.0 | 7.0 |
| 18 | .6 | ..... | ..... | ..... | ..... | .7 | 960 | 585 | 127 | 25 | 4.0 | 7.0 |
| 19 | .6 | ..... | ..... | ..... | ..... | .7 | 1,260 | 517 | 101 | 25 | 7.0 | 7.0 |
| 20 | .6 | ..... | .6 | ..... | ..... | .6 | 1,300 | 444 | 101 | 25 | 7.0 | 7.0 |
| 21 | .6 | ..... | ..... | ..... | .5 | .6 | 1,420 | 418 | 85 | 21 | 4.0 | 9.0 |
| 22 | .5 | 1.1 | ..... | ..... | ..... | .6 | 1,530 | 390 | 101 | 21 | 4.0 | 9.0 |
| 23 | .5 | ..... | ..... | ..... | ..... | .7 | 1,610 | 309 | 101 | 17 | 4.0 | 9.0 |
| 24 | .5 | ..... | ..... | .5 | ..... | .7 | 1,680 | 309 | 85 | 17 | 3.2 | 7.0 |
| 25 | .5 | ..... | ..... | ..... | ..... | .8 | 1,710 | 284 | 78 | 17 | 3.2 | 9.0 |
| 26 | .5 | ..... | ..... | ..... | ..... | .8 | 1,770 | 260 | 70 | 17 | 3.2 | 9.0 |
| 27 | .5 | ..... | .6 | ..... | ..... | .8 | 1,790 | 248 | 78 | 21 | 2.4 | 9.0 |
| 28 | .5 | ..... | ..... | ..... | ..... | 1.6 | 1,840 | 237 | 78 | 25 | 2.4 | 11.0 |
| 29 | .6 | 1.1 | ..... | ..... | .4 | 7.0 | 1,910 | 215 | 85 | 21 | 2.4 | 11.0 |
| 30 | .6 | ..... | ..... | ..... | ..... | 70 | 1,960 | 204 | 70 | 17 | 3.2 | 9.0 |
| 31 | .6 | ..... | ..... | .5 | ..... | 335 | ..... | 215 | ..... | 17 | 3.2 | ..... |

NOTE.—During periods Oct. 1, 1918, to Mar. 21, 1919, and Nov. 1, 1919, to Mar. 12, 1920, gage was not read on days for which no discharge is given. Mean discharge during period Oct. 1, 1918, to Mar. 21, 1919, estimated as follows: Oct. 1 to Nov. 30, 18 second-feet; Dec. 1–31, 1918, 18. 5 second-feet; Jan. 1–31, 11 second-feet: Feb. 1–28, 6.5 second-feet; and Mar. 1–21, 1919, 7 second-feet. Discharge estimated on account of lack of gage readings, Sept. 28–30, Oct. 19–24, 26–31, 1919, Mar. 18, 19, 21–26, 1920.

*Monthly discharge of Mouse River at Minot, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Discharge in second-feet. | | | Run-off in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1918–19. | | | | |
| October | ..... | ..... | 18 | 1,11( |
| November | ..... | ..... | 18 | 1,070 |
| December | ..... | ..... | 18.5 | 1,140 |
| January | ..... | ..... | 11 | 676 |
| February | ..... | ..... | 6.5 | 361 |
| March | 118 | ..... | 20 | 1,230 |
| April | 1,860 | 155 | 1,200 | 71,40( |
| May | 469 | 56 | 199 | 12,200 |
| June | 50 | 17 | 33.3 | 1,980 |
| July | 25 | 5.5 | 11.1 | 682 |
| August | 4.0 | .7 | 2.2 | 135 |
| September | 1.0 | .7 | .8 | 49 |
| The year | 1,860 | ..... | 127 | 92,000 |
| 1919–20. | | | | |
| October | .7 | .5 | .60 | 36.9 |
| March 13–31 | ..... | ..... | 22.4 | 844 |
| April | 1,960 | 25 | 871 | 51,800 |
| May | 2,560 | 204 | 1,220 | 75,000 |
| June | 194 | 70 | 129 | 7,680 |
| July | 85 | 17 | 34.6 | 2,130 |
| August | 17 | 2.4 | 7.07 | 435 |
| September | 11 | 2.4 | 6.27 | 373 |

## EVAPORATION AT UNIVERSITY, N. DAK.[4]

The evaporation gage at University, N. Dak., was established April 17, 1905, on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

The coulee drains about 60 square miles of very level prairie. Except for brief freshets the flow in the coulee is small, varying from 1 second-foot or less to 20 second-feet. In very dry weather the water lies in pools with scarcely any perceptible flow.

A heavy galvanized iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

On the open prairie 40 rods distant is a standard rain gage. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the evaporation for the day.

Observations were made usually about half an hour before sunset. The temperature of the water recorded is the temperature of the water in the tank. As the tank is made of metal, it has been found that at that time of day there is seldom a perceptible difference in temperature reading between the water within and without the tank. The temperature of the air as recorded is the mean of the readings of the standard self-recording maximum and the self-recording minimum thermometers for the preceding 24 hours.

The following table shows for each 10-day period during the years ending September 30, 1919 and 1920, the gross evaporation, the total rainfall, and the mean temperatures for the 10 observations of the water and of the air.

[4] For complete description of this station and records of evaporation, rainfall, and temperature for 1905 to 1908, see U. S. Geol. Survey Water-Supply Paper 245, pp. 64–67, 1910.

*Evaporation observations at University, N. Dak., for the years ending Sept. 30, 1919 and 1920.*

| Date. | Evaporation. | Rainfall. | Mean temperature (°F.). | | Date. | Evaporation. | Rainfall. | Mean temperature (°F.). | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Water. | Air. | | | | Water. | Air. |
| 1918-19. | *Inches.* | *Inches.* | | | 1918-19. | *Inches.* | *Inches.* | | |
| Oct. 1-10 | 0.50 | 0.23 | 52 | 51 | Aug. 11-20 | 1.53 | 0.53 | 68 | 69 |
| 11-20 | .75 | .19 | 45 | 51 | 21-31 | 1.97 | .99 | 63 | 60 |
| 21-31 | .14 | .78 | 34 | 37 | Sept. 1-10 | 1.26 | .12 | 62 | 64 |
| Nov. 1-10 | .20 | .60 | 33 | 36 | 11-20 | 1.54 | 1.72 | 59 | 62 |
| 11-20 | .18 | .43 | 32 | 32 | 21-30 | 1.34 | .39 | 54 | 49 |
| Apr. 27-30 | .51 | .00 | 54 | 44 | 1919-20. | | | | |
| May 1-10 | 1.49 | 2.52 | 53 | 45 | Oct. 1-10 | 1.26 | .19 | 48 | 46 |
| 11-20 | 1.69 | .79 | 62 | 55 | 11-20 | .38 | .01 | 45 | 33 |
| 21-31 | 2.59 | 1.31 | 74 | 67 | 21-23 | .12 | .00 | 44 | 33 |
| June 1-10 | 2.09 | .74 | 69 | 57 | Apr. 26-30 | .43 | .00 | 54 | 42 |
| 11-20 | 2.25 | .61 | 79 | 73 | May 1-10 | 1.64 | .09 | 59 | 53 |
| 21-30 | 2.13 | 1.04 | 75 | 72 | 11-20 | 1.81 | .26 | 60 | 54 |
| July 1-10 | 2.38 | 2.09 | 77 | 70 | 21-31 | 2.29 | 1.68 | ..... | 57 |
| 11-20 | 1.87 | .95 | 73 | 68 | June 1-10 | 1.99 | .74 | ..... | 60 |
| 21-31 | 2.18 | 1.12 | 72 | 71 | 11-14 | .75 | .06 | ..... | 70 |
| Aug. 1-10 | 3.53 | 1.46 | 70 | 69 | | | | | |

NOTE.—Station temporarily discontinued June 15, 1920.

### KAWISHIWI RIVER NEAR WINTON, MINN.

LOCATION.—In sec. 20, T. 62 N., R. 11 W., in pond above lower dam of St. Croix Lumber Co. at Kawishiwi Falls, 500 feet above Fall Lake, 3,000 feet below Garden Lake, near west line of Lake County, and 2½ miles east of Winton, St. Louis County.

DRAINAGE AREA.—1,200 square miles.

RECORDS AVAILABLE.—June 21, 1905, to June 30, 1907; October 14, 1912, to September 30, 1919, when station was discontinued.

GAGE.—Stevens water-stage recorder installed the latter part of September, 1912, by the International Joint Commission in cooperation with the United States Geological Survey, at a point just above right end of dam. Well was attached to timbers, which were bolted to the vertical rock wall of right bank of river. Auxiliary staff gage was also attached to one of these timbers. The gage shelter was supported by timbers which were bolted to the horizontal portion of the rock wall above all possible high water. On May 27, 1913, the Stevens was replaced by a Friez water-stage recorder. During the high water of June, 1914, the well together with the float and weight were carried away by logs. At this time a concrete well was installed by the International Joint Commission a little below the dam and outside the river channel, and connected with pool above the dam by a pipe through the dam. The gage was repaired and again put in operation about July 1, 1914. Both water-stage recorders refer to the same datum. Attended by G. W. Byshe.

DISCHARGE MEASUREMENTS.—Made from cable about 1,000 feet above gage.

CHANNEL AND CONTROL.—At the gage the river flows through a small deep pool formed by a timber dam without openings, which constitutes the control of the gage, and is permanent unless dam is destroyed or alterations are made in the crest About 200 feet above dam is a decided fall. Banks high enough to prevent overflow in vicinity of gage. At measuring section bed of stream is composed of rock and boulders; rather rough. Current very swift except at low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.58 feet at 11 a. m. April 30 (discharge, 2,500 second-feet); minimum stage, 0.35 foot September 22–30 (discharge, 30 second-feet).

1905–1907 and 1912–1919: Maximum stage recorded, 7.2 feet April 30 and May 7, 1916 (discharge, 5,370 second-feet); no flow, August 24, 25, 30, 31, and September 1, 1905, August 6 and 8, 1906, and April 23, 24, and 26, 1907; caused by regulation at outlet of Garden Lake.

ICE.—Stage-discharge relation not seriously affected by ice.

REGULATION.—St. Croix Lumber Co. has a dam at outlet of Garden Lake for controlling the level of water in that lake, and for storing water to be used in driving logs over the stretch of rapids between Garden and Fall lakes. This dam is capable of holding the water in Garden Lake about 7 or 8 feet above its natural level at low water before water will flow over the gates. When the water in Garden Lake is held at a high stage, the elevation of water is considerably higher in Farm Lake, and it is understood that the elevation of the surface of White Iron Lake is somewhat affected by the stage of Garden Lake. During the log driving season, April to November, the water in Garden Lake is held to the elevation of top of gates practically all the time. In November some of the gates are opened so that the lake is drawn down to low-water stage, and remains so until spring. St. Croix Lumber Co. has a dam at outlet of Birch Lake, which controls its elevation, and is capable of holding the water about 5 feet above low water. This dam is left open during winter and until high water of the spring break-up has passed. It is then closed, and the lake held as high as possible during the summer. There are a number of low dams in Stony River used for sluicing logs off rapids, but these have no storage of importance back of them. Large volumes of water are allowed to pass through sluices of dam at outlet of Garden Lake for a few hours at a time, at irregular intervals, when desired to drive logs from Garden Lake to Fall Lake. At other times these gates are closed so that there is only a slight flow caused by leakage through dam. At other times some of the gates are partly opened to allow passage of sufficient water to prevent flow over crest of dam. During the year there was little log driving on rivers.

ACCURACY.—Stage-discharge relation permanent; not affected by ice or logs. Rating curve fairly well defined below 2,890 second-feet. Continuous gage record from recording gage during open-water period; weekly gage readings during winter. Daily discharge ascertained as follows: October 1 to 31 and April 23 to September 30, obtained from water-stage recorder graph by means of discharge integrator; April 21 and 22 interpolated, on account of lack of gage readings; ten-day averages, November 1 to April 20, based on weekly gage readings. Records good for periods when water-stage recorder was operating; fair for other periods. Information as to operation of gates in dam at outlet of Garden Lake given in footnote to table of daily discharge.

No discharge measurements were made at this station during the year

*Daily discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 275 | | | | | | | 2,290 | 1,520 | 788 | 66 | 48 |
| 2 | 595 | | | | | | | 2,200 | 1,550 | 782 | 66 | 48 |
| 3 | 404 | | | | | | | 2,150 | 1,490 | 776 | 66 | 48 |
| 4 | 295 | | | | | | | 2,120 | 1,440 | 770 | 62 | 48 |
| 5 | 376 | | | | | | | 2,080 | 1,040 | 602 | 60 | 48 |
| | | 65 | 55 | 195 | 160 | 135 | 350 | | | | | |
| 6 | 127 | | | | | | | 2,080 | 898 | 522 | 57 | 48 |
| 7 | 122 | | | | | | | 2,080 | 943 | 522 | 56 | 48 |
| 8 | 122 | | | | | | | 2,080 | 879 | 522 | 55 | 46 |
| 9 | 119 | | | | | | | 2,080 | 898 | 434 | 54 | 46 |
| 10 | 116 | | | | | | | 2,080 | 1,000 | 391 | 53 | 44 |
| 11 | 116 | | | | | | | 2,070 | 1,120 | 391 | 48 | 44 |
| 12 | 111 | | | | | | | 2,060 | 1,090 | 396 | 48 | 42 |
| 13 | 108 | | | | | | | 2,030 | 1,100 | 391 | 48 | 42 |
| 14 | 240 | | | | | | | 1,940 | 1,080 | 387 | 48 | 38 |
| 15 | 113 | | | | | | | 1,860 | 1,100 | 387 | 48 | 36 |
| | | 55 | 210 | 185 | 150 | 125 | 800 | | | | | |
| 16 | 113 | | | | | | | 1,600 | 1,100 | 331 | 48 | 35 |
| 17 | 94 | | | | | | | 1,520 | 1,120 | 186 | 48 | 33 |
| 18 | 72 | | | | | | | 1,350 | 1,140 | 231 | 48 | 33 |
| 19 | 62 | | | | | | | 1,390 | 1,170 | 136 | 48 | 33 |
| 20 | 59 | | | | | | 1,270 | 1,410 | 1,170 | 68 | 48 | 32 |
| 21 | 62 | | | | | | 1,250 | 1,430 | 1,170 | 66 | 48 | 32 |
| 22 | 68 | | | | | | 1,230 | 1,440 | 1,130 | 64 | 48 | 30 |
| 23 | 68 | | | | | | 1,200 | 1,450 | 1,080 | 64 | 48 | 30 |
| 24 | 68 | | | | | | 1,210 | 1,450 | 1,080 | 64 | 48 | 30 |
| 25 | 68 | | | | 140 | | 1,220 | 1,460 | 1,060 | 64 | 48 | 30 |
| | | 50 | 225 | 165 | | 125 | | | | | | |
| 26 | 68 | | | | | | 1,090 | 1,500 | 1,030 | 66 | 48 | 30 |
| 27 | 68 | | | | | | 989 | 1,520 | 1,010 | 66 | 48 | 30 |
| 28 | 68 | | | | | | 1,240 | 1,530 | 963 | 66 | 48 | 30 |
| 29 | 68 | | | | ..... | | 1,520 | 1,550 | 877 | 66 | 48 | 30 |
| 30 | 66 | | | | ..... | | 2,070 | 1,520 | 805 | 66 | 48 | 30 |
| 31 | 65 | ..... | | | ..... | | ..... | 1,500 | ..... | 66 | 48 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated. Gates in dam at outlet of Garden Lake known to have been opened or closed, Oct. 1, 5, 14, 1918, Apr. 5, 26, 28, 30, May 16, 17, June 5, 10, 29, and July 5, 9, 16, 17, 19, 1919.

*Monthly discharge of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1919.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| October | 595 | 59 | 141 |
| November | ..... | ..... | 56.7 |
| December | ..... | ..... | 165 |
| January | ..... | ..... | 181 |
| February | ..... | ..... | 151 |
| March | ..... | ..... | 128 |
| April | 2,070 | ..... | 333 |
| May | 2,290 | 1,350 | 1,770 |
| June | 1,550 | 805 | 1,100 |
| July | 788 | 64 | 314 |
| August | 66 | 48 | 51.7 |
| September | 48 | 30 | 38.1 |
| The year | 2,290 | 30 | 412 |

## UPPER MISSISSIPPI RIVER BASIN.

### MISSISSIPPI RIVER AT ELK RIVER, MINN.

LOCATION.—In sec. 3, T. 121 N., R. 23 W., at highway bridge in Elk River, Sherburne County, 2,500 feet below mouth of Elk River.

DRAINAGE AREA.—14,500 square miles.

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1920.

GAGE.—Chain gage bolted to handrail of bridge, downstream side, near right bank; read by Reynard Ebner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 7.23 feet at 7.28 a. m. April 15 (discharge, 14,800 second-feet); minimum open-water stage recorded, 2.38 feet at 6.51 p. m. October 15 (discharge, about 1,890 second-feet); minimum discharge may have occurred during ice-affected period.

Maximum open-water stage recorded during year ending September 30, 1920, 9.77 feet at 8 a. m. March 28 (discharge, 24,100 second-feet); minimum discharge, estimated 1,880 second-feet November 13 (stage-discharge relation affected by ice).

1915–1920: Maximum open-water stage recorded during period, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); maximum discharge probably occurred on or about April 5, 1917, and has been estimated at about 34,000 second-feet, from records of discharge at Coon Rapids power plant; minimum discharge estimated, 1,880 second-feet November 13, 1919 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Nearest dam above station on the Mississippi is at St. Cloud, 40 miles upstream. An observed systematic diurnal fluctuation at gage of about 0.1 foot is doubtless due to regulation at St. Cloud; but most of the effect of regulation is eliminated before reaching the station. Flow of river is controlled by Government dams on the upper river for the purpose of increasing low-water open-season flow in the interests of navigation.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 4,620 and 12,400 second-feet, and fairly well defined between 12,400 and 26,300 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records excellent; winter records fair.

COOPERATION.—Gage readings furnished by United States Engineer Corps.

*Discharge measurements of Mississippi River at Elk River, Minn., during the years ending Sept. 30, 1919 and 1920.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| 1918. | *Feet.* | *Sec.-ft.* | 1919. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* |
| Nov. 6..... | 2.78 | 2,240 | Apr. 20..... | 6.39 | 10,900 | June 23..... | 6.88 | 13,400 |
| | | | Oct. 23..... | 4.13 | 4,950 | Sept. 5..... | 4.36 | 5,530 |

*Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 2,190 | 2,700 | | | | | 9,520 | 7,620 | 3,840 | 7,930 | 4,080 | 4,080 |
| 2 | 2,300 | 2,550 | | | | | 10,500 | 7,620 | 4,080 | 7,310 | 3,610 | 4,340 |
| 3 | 2,190 | 2,300 | | | | | 9,840 | 7,310 | 4,080 | 7,000 | 4,080 | 4,620 |
| 4 | 2,300 | 2,420 | | | | | 9,200 | 7,000 | 4,080 | 7,000 | 3,840 | 4,910 |
| 5 | 2,300 | 2,300 | | | | | 9,840 | 7,930 | 4,080 | 6,700 | 3,840 | 4,910 |
| 6 | 2,090 | 2,420 | | | | | 9,200 | 6,400 | 4,910 | 5,800 | 3,610 | 5,800 |
| 7 | 2,090 | 2,420 | | | | | 10,200 | 7,930 | 4,620 | 5,200 | 4,620 | 5,500 |
| 8 | 2,190 | 2,420 | | | | | 11,400 | 7,930 | 5,500 | 4,910 | 4,080 | 5,800 |
| 9 | 2,420 | 2,550 | | | | | 11,400 | 8,240 | 6,700 | 5,200 | 4,340 | 5,200 |
| 10 | 2,300 | 2,700 | | | | | 12,700 | 8,240 | 7,620 | 5,200 | 4,340 | 5,200 |
| 11 | 2,300 | 2,700 | | | | | 13,000 | 8,880 | 7,930 | 4,620 | 4,340 | 5,500 |
| 12 | 2,300 | 2,860 | | | | | 13,400 | 9,520 | 7,930 | 4,340 | 4,620 | 5,200 |
| 13 | 2,190 | 2,700 | | | | | 13,700 | 9,840 | 8,240 | 4,620 | 4,340 | 4,910 |
| 14 | 2,090 | 2,860 | | | | | 14,000 | 9,520 | 8,560 | 5,200 | 4,620 | 5,500 |
| 15 | 2,090 | 2,860 | | | 2,200 | | 14,700 | 8,560 | 9,840 | 4,620 | 4,620 | 5,200 |
| 16 | 2,190 | 2,700 | 2,450 | 2,400 | | 7,100 | 13,700 | 8,880 | 10,200 | 4,340 | 4,620 | 4,620 |
| 17 | 2,190 | 3,030 | | | | | 13,000 | 8,560 | 9,200 | 4,080 | 4,340 | 4,080 |
| 18 | 2,420 | 3,610 | | | | | 12,700 | 8,240 | 9,200 | 3,840 | 4,340 | 4,620 |
| 19 | 2,190 | 3,840 | | | | | 12,400 | 7,620 | 9,200 | 3,610 | 4,620 | 4,620 |
| 20 | 2,190 | 3,840 | | | | | 11,800 | 7,620 | 8,240 | 3,840 | 4,340 | 4,340 |
| 21 | 2,090 | 3,840 | | | | | 11,800 | 7,310 | 7,620 | 4,080 | 4,340 | 4,620 |
| 22 | 2,090 | 3,610 | | | | | 10,800 | 7,000 | 7,310 | 3,610 | 4,080 | 4,620 |
| 23 | 2,300 | 3,210 | | | | | 10,500 | 6,700 | 7,930 | 3,610 | 4,340 | 4,340 |
| 24 | 2,420 | 3,030 | | | | | 9,840 | 6,100 | 7,930 | 3,400 | 3,840 | 4,080 |
| 25 | 2,550 | 3,030 | | | | | 9,520 | 5,800 | 8,240 | 3,610 | 4,080 | 4,340 |
| 26 | 2,700 | 3,030 | | | | | 8,880 | 5,500 | 8,240 | 3,840 | 3,840 | 4,340 |
| 27 | 2,550 | 2,420 | | | | | 9,520 | 4,340 | 8,560 | 4,080 | 3,610 | 4,340 |
| 28 | 2,860 | 2,300 | | | | | 8,880 | 4,620 | 8,560 | 3,840 | 3,610 | 4,340 |
| 29 | 2,700 | 2,300 | | | ..... | | 7,930 | 4,340 | 8,560 | 3,610 | 3,840 | 4,340 |
| 30 | 2,860 | 2,420 | | | ..... | | 7,310 | 4,340 | 8,240 | 3,610 | 4,340 | 4,080 |
| 31 | 2,700 | ..... | | | ..... | | ..... | 4,080 | ..... | 3,840 | 4,620 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 4,340 | 5,200 | 2,550 | 3,260 | 2,740 | 2,260 | 19,100 | 11,400 | 8,880 | 18,800 | 5,800 | 5,200 |
| 2 | 5,200 | 5,200 | 2,330 | 3,150 | 2,560 | 2,660 | 18,800 | 12,100 | 10,200 | 19,400 | 5,500 | 5,500 |
| 3 | 5,500 | 5,200 | 2,920 | 3,420 | 2,530 | 2,740 | 17,400 | 10,800 | 8,880 | 19,400 | 5,200 | 5,800 |
| 4 | 5,500 | 5,200 | 3,230 | 3,270 | 2,380 | 2,480 | 16,000 | 9,520 | 14,000 | 18,800 | 5,200 | 5,500 |
| 5 | 5,800 | 4,620 | 3,530 | 3,140 | 2,180 | 2,380 | 16,000 | 9,840 | 14,700 | 18,400 | 5,500 | 5,500 |
| 6 | 5,200 | 4,340 | 3,730 | 3,180 | 2,310 | 2,480 | 14,300 | 9,520 | 15,000 | 18,100 | 5,200 | 4,910 |
| 7 | 4,910 | 4,080 | 3,710 | 3,200 | 2,600 | 2,410 | 14,000 | 9,200 | 15,000 | 17,400 | 5,200 | 4,620 |
| 8 | 5,200 | 4,080 | 3,600 | 3,350 | 2,400 | 2,200 | 13,400 | 8,880 | 15,700 | 16,400 | 4,620 | 4,910 |
| 9 | 5,200 | 3,030 | 3,630 | 3,310 | 2,390 | 2,310 | 13,400 | 8,880 | 15,700 | 15,700 | 4,080 | 4,620 |
| 10 | 5,200 | 4,340 | 3,480 | 2,990 | 2,510 | 2,150 | 12,700 | 9,520 | 15,000 | 15,000 | 4,620 | 5,200 |
| 11 | 5,500 | 4,080 | 3,080 | 2,940 | 2,650 | 2,480 | 12,700 | 12,100 | 16,400 | 14,700 | 4,620 | 5,800 |
| 12 | 5,200 | 3,840 | 3,420 | 2,870 | 2,590 | 2,450 | 12,700 | 13,700 | 16,400 | 13,400 | 4,910 | 5,500 |
| 13 | 5,200 | 1,880 | 3,470 | 2,960 | 2,450 | 2,690 | 12,400 | 13,000 | 16,700 | 12,100 | 5,200 | 5,800 |
| 14 | 5,200 | 2,830 | 3,310 | 2,960 | 2,580 | 2,610 | 12,100 | 13,700 | 17,400 | 12,100 | 5,500 | 5,800 |
| 15 | 5,200 | 3,040 | 3,250 | 2,860 | 2,320 | 3,120 | 11,800 | 12,700 | 18,400 | 10,200 | 5,500 | 5,800 |
| 16 | 4,910 | 3,150 | 3,280 | 2,710 | 2,350 | 3,370 | 10,200 | 12,400 | 18,400 | 10,800 | 5,500 | 5,800 |
| 17 | 5,200 | 3,840 | 3,410 | 2,970 | 2,650 | 3,230 | 9,520 | 12,100 | 18,400 | 10,500 | 5,800 | 5,800 |
| 18 | 4,910 | 4,800 | 3,260 | 2,840 | 2,690 | 3,610 | 9,520 | 11,100 | 17,700 | 9,840 | 5,500 | 6,100 |
| 19 | 5,200 | 4,730 | 3,370 | 2,760 | 2,540 | 3,890 | 9,840 | 10,800 | 17,700 | 9,840 | 5,500 | 6,400 |
| 20 | 5,500 | 5,070 | 3,360 | 2,740 | 2,580 | 5,980 | 9,200 | 9,520 | 17,100 | 9,200 | 6,100 | 6,700 |
| 21 | 4,910 | 5,460 | 3,280 | 2,990 | 2,500 | 4,470 | 9,840 | 8,560 | 16,000 | 8,560 | 6,100 | 5,800 |
| 22 | 4,910 | 5,530 | 3,590 | 2,490 | 2,480 | 5,620 | 9,520 | 8,880 | 14,700 | 8,560 | 5,800 | 6,100 |
| 23 | 5,200 | 5,660 | 3,270 | 2,680 | 2,260 | 7,360 | 10,200 | 9,840 | 13,700 | 7,620 | 5,800 | 5,800 |
| 24 | 5,200 | 5,580 | 4,000 | 2,820 | 2,610 | 12,200 | 10,500 | 10,200 | 12,700 | 7,000 | 5,800 | 5,800 |
| 25 | 5,200 | 4,480 | 3,260 | 2,630 | 2,500 | 17,000 | 11,400 | 10,200 | 12,100 | 6,700 | 5,800 | 5,200 |
| 26 | 5,200 | 3,820 | 3,310 | 2,370 | 2,610 | 21,800 | 12,100 | 9,840 | 11,100 | 6,400 | 5,800 | 5,800 |
| 27 | 5,200 | 2,720 | 3,020 | 2,710 | 2,440 | 22,200 | 12,100 | 9,840 | 12,100 | 6,400 | 5,500 | 5,500 |
| 28 | 5,200 | 2,940 | 3,170 | 2,670 | 2,450 | 22,800 | 12,100 | 9,200 | 12,700 | 6,700 | 5,200 | 6,100 |
| 29 | 4,910 | 3,350 | 3,250 | 2,520 | 2,410 | 21,100 | 12,100 | 8,880 | 14,000 | 6,700 | 5,200 | 5,800 |
| 30 | 5,200 | 2,940 | 3,380 | 2,570 | ..... | 20,800 | 12,100 | 8,560 | 16,000 | 7,000 | 5,200 | 6,100 |
| 31 | 5,500 | ..... | 3,530 | 2,490 | ..... | 20,100 | ..... | 8,880 | ..... | 6,400 | 5,500 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 1, 1918, to Mar. 31, 1919, and Nov. 13, 1919, to Mar. 25, 1920; mean discharge for former period and daily discharge for latter period ascertained by means of discharge records from Coon Rapids power plant, computed by Northern States Power Co., allowance being made for discharge of Crow and Rum rivers, which enter between Coon Rapids and the gaging station. Braced figures indicate mean discharge for periods included.

*Monthly discharge of Mississippi River at Elk River, Minn., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 14,500 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,860 | 2,090 | 2,330 | 0.161 | 0.19 |
| November | 3,840 | 2,300 | 2,830 | .195 | .22 |
| December | ..... | ..... | 2,450 | .169 | .19 |
| January | ..... | ..... | 2,400 | .166 | .19 |
| February | ..... | ..... | 2,200 | .152 | .16 |
| March | ..... | ..... | 7,100 | .490 | .56 |
| April | 14,700 | 7,310 | 11,000 | .759 | .85 |
| May | 9,840 | 4,080 | 7,210 | .497 | .57 |
| June | 10,200 | 3,840 | 7,310 | .504 | .56 |
| July | 7,930 | 3,400 | 4,730 | .326 | .38 |
| August | 4,620 | 3,610 | 4,190 | .289 | .33 |
| September | 5,800 | 4,080 | 4,750 | .328 | .37 |
| The year | 14,700 | ..... | 4,880 | .337 | 4.57 |
| 1919–20. | | | | | |
| October | 5,800 | 4,340 | 5,180 | .357 | .41 |
| November | 5,660 | 1,880 | 4,170 | .288 | .32 |
| December | 4,000 | 2,330 | 3,320 | .229 | .26 |
| January | 3,420 | 2,370 | 2,900 | .200 | .23 |
| February | 2,740 | 2,180 | 2,490 | .172 | .19 |
| March | 22,800 | 2,150 | 7,510 | .518 | .60 |
| April | 19,100 | 9,200 | 12,600 | .869 | .97 |
| May | 13,700 | 8,560 | 10,400 | .717 | .83 |
| June | 18,400 | 8,880 | 14,800 | 1.02 | 1.14 |
| July | 19,400 | 6,400 | 11,900 | .821 | .95 |
| August | 6,100 | 4,080 | 5,380 | .371 | .43 |
| September | 6,700 | 4,620 | 5,640 | .389 | .43 |
| The year | 22,800 | 1,880 | 7,190 | .496 | 6.76 |

### MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.—At Chicago Great Western Railway bridge near foot of Robert Street, St. Paul, Ramsey County, 6 miles below mouth of Minnesota River.

DRAINAGE AREA.—35,700 square miles.

RECORDS AVAILABLE.—March 22, 1887, to September 30, 1920. Observations of stage were begun in 1873 by United States Signal Service and continued by United States Weather Bureau. Many discharge measurements were made prior to 1900 by United States Engineer Corps.

GAGE.—Chain gage installed May 9, 1913, on handrail, downstream side, of Chicago Great Western Railway bridge, near foot of Robert Street; read by United States Weather Bureau employees. From 1911 to May 9, 1913, the gage was a vertical staff attached to a piling on left bank of river about 800 feet upstream from present gage. Prior to 1911 a vertical staff gage on Diamond Joe Line wharf, at foot of Jackson Street, about 400 feet below chain gage, was used. The datum of all three gages is the same, allowance being made for the slight slope in river between them.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1918, 7.5 feet March 24 and 25 (discharge, 20,900 second-feet); minimum stage recorded, —1.0 foot September 30 (discharge, 2,630 second-feet).

Maximum stage recorded during year ending September 30, 1919, 13.8 feet April 22 (discharge, 54,500 second-feet); minimum stage recorded, —0.7 foot October 21 (discharge, 2,920 second-feet).

Maximum stage recorded during year ending September 30, 1920, 13.6 feet March 29 (discharge, 53,100 second-feet); minimum stage recorded, 0.4 foot November 14 (discharge, 4,220 second-feet).

1887–1920: Maximum stage recorded, 18.0 feet April 6, 1897 (discharge, 80,800 second-feet); minimum discharge recorded, 1,060 second-feet February 4, 1895.

Highest known discharge occurred July 22, 1867, and amounted to 117,000 second-feet.

DISCHARGE MEASUREMENTS.—Up to 1915 made from Chicago, St. Paul, Minneapolis & Omaha Railway bridge, 2 miles above station; in November, 1915, and April, 1916, measurements were made from Chicago Great Western Railway bridge to which present gage is attached. Since 1916 measurements have been made from Wabasha Street highway bridge, about 1,000 feet above station.

CHANNEL AND CONTROL.—Channel somewhat shifting. Control not well defined. Banks moderately high; have not been overflowed in recent years.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—During extreme low-water regulation of the flow through turbines at the nearest dam in Minneapolis may cause diurnal fluctuation of stage at St. Paul. Flow is regulated by Government reservoirs on the headwaters at Lake Winnebigoshish, Leach Lake, Pokegama Lake, Sandy Lake, Pine River, and Gull Lake, to increase the low-water open-season flow in the interests of navigation, but the effect of this regulation is very gradual at St. Paul.

ACCURACY.—Stage-discharge relation changed between September 12 and October 9, 1917, owing to dredging of channel beginning at a point about a third of a mile below gage and terminating 3,000 feet farther downstream. Since the dredging was completed stage-discharge relation has been practically permanent except as affected by ice. Two rating curves used during 1918, 1919, and 1920; one, applicable October 1, 1917, to September 30, 1919, is fairly well defined, the other, a revision of the 1918 and 1919 curve between 6,830 and 42,000 second-feet, and applicable October 1, 1919, to September 30, 1920, is well defined between 6,000 and 48,000 second-feet. Gage read to tenths once daily. Daily-discharge ascertained by applying daily gage height to rating table except during pericds of ice effect, December 7, 1917, to March 17, 1918, December 11, 1918, to March 14, 1919, and December 2, 1919, to March 8, 1920, for which no estimates of discharge were made. Records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Mississippi River at St. Paul, Minn., during the years ending Sept. 30, 1919 and 1920.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| 1918. | *Feet.* | *Sec.-ft.* | 1919. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* |
| Nov. 5 | 2.22 | 7,180 | Apr. 5–6 | 12.41 | 45,000 | May 14 | 7.34 | 22,500 |
| | | | Oct. 21 | 1.93 | 6,680 | June 22 | 9.87 | 31,000 |
| | | | | | | Sept. 7 | 2.74 | 8,280 |

*Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the years ending Sept. 30, 1918–1920.*

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| **1917–18.** | | | | | | | | | | |
| 1 | 7,020 | 6,450 | 4,490 | ..... | 11,700 | 6,090 | 16,100 | 6,830 | 7,400 | 9,870 |
| 2 | 7,020 | 6,450 | 3,480 | ..... | 11,200 | 6,270 | 16,400 | 6,830 | 6,090 | 8,790 |
| 3 | 7,020 | 5,910 | 3,360 | ..... | 10,800 | 6,450 | 17,300 | 6,640 | 6,090 | 8,190 |
| 4 | 6,640 | 5,560 | 3,360 | ..... | 10,500 | 7,020 | 17,600 | 6,830 | 5,560 | 7,990 |
| 5 | 6,830 | 6,090 | 2,630 | ..... | 9,870 | 7,590 | 16,700 | 6,270 | 5,070 | 7,790 |
| 6 | 6,830 | 6,450 | 2,860 | ..... | 9,870 | 7,590 | 17,000 | 7,020 | 5,230 | 7,210 |
| 7 | 6,830 | 6,450 | ..... | ..... | 9,000 | 7,990 | 16,400 | 5,910 | 5,230 | 7,020 |
| 8 | 6,640 | 6,640 | ..... | ..... | 8,590 | 6,830 | 15,500 | 5,230 | 5,390 | 6,270 |
| 9 | 7,020 | 6,450 | ..... | ..... | 9,210 | 7,020 | 16,100 | 6,640 | 5,070 | 5,230 |
| 10 | 6,640 | 6,640 | ..... | ..... | 8,390 | 8,790 | 15,000 | 6,270 | 5,560 | 5,560 |
| 11 | 7,210 | 6,640 | ..... | ..... | 7,990 | 9,000 | 14,700 | 5,560 | 5,560 | 5,730 |
| 12 | 6,830 | 6,090 | ..... | ..... | 7,590 | 9,000 | 12,900 | 6,090 | 5,070 | 5,560 |
| 13 | 6,640 | 6,270 | ..... | ..... | 7,400 | 9,430 | 12,900 | 5,730 | 5,910 | 5,560 |
| 14 | 6,640 | 6,270 | ..... | ..... | 7,210 | 9,870 | 11,700 | 6,090 | 5,390 | 5,230 |
| 15 | 6,830 | 6,450 | ..... | ..... | 6,640 | 10,500 | 10,800 | 5,910 | 5,230 | 5,070 |
| 16 | 7,020 | 6,270 | ..... | ..... | 6,270 | 10,800 | 10,500 | 5,910 | 5,230 | 4,630 |
| 17 | 6,090 | 6,090 | ..... | ..... | 6,640 | 11,000 | 9,650 | 5,730 | 5,230 | 4,920 |
| 18 | 6,450 | 5,910 | ..... | 7,590 | 7,020 | 9,650 | 9,430 | 5,230 | 5,730 | 4,770 |
| 19 | 6,830 | 5,910 | ..... | 10,800 | 6,450 | 9,650 | 8,790 | 5,730 | 8,790 | 4,920 |
| 20 | 6,830 | 5,730 | ..... | 12,400 | 6,450 | 9,870 | 8,790 | 5,730 | 11,000 | 5,070 |
| 21 | 6,830 | 5,560 | ..... | 18,200 | 6,450 | 9,650 | 8,190 | 5,730 | 12,200 | 4,630 |
| 22 | 7,020 | 5,390 | ..... | 18,900 | 5,910 | 9,430 | 7,990 | 4,920 | 13,900 | 4,630 |
| 23 | 7,400 | 5,730 | ..... | 19,900 | 5,910 | 9,870 | 8,190 | 5,730 | 13,900 | 3,840 |
| 24 | 6,450 | 5,390 | ..... | 20,900 | 6,450 | 10,300 | 7,400 | 5,730 | 13,400 | 3,840 |
| 25 | 6,830 | 5,390 | ..... | 20,900 | 6,640 | 10,800 | 7,790 | 5,230 | 14,400 | 3,840 |
| 26 | 7,210 | 5,390 | ..... | 18,200 | 6,270 | 12,400 | 7,400 | 5,390 | 14,400 | 3,720 |
| 27 | 7,590 | 5,390 | ..... | 16,400 | 6,090 | 13,200 | 6,830 | 5,230 | 14,700 | 4,220 |
| 28 | 7,790 | 4,920 | ..... | 15,000 | 6,090 | 13,900 | 7,590 | 5,230 | 13,900 | 3,720 |
| 29 | 7,400 | 4,770 | ..... | 13,700 | 5,730 | 12,900 | 7,020 | 5,560 | 13,400 | 3,840 |
| 30 | 7,020 | 4,490 | ..... | 12,600 | 5,560 | 14,200 | 7,400 | 7,400 | 11,900 | 3,360 |
| 31 | 6,830 | ..... | ..... | 12,400 | ..... | 15,500 | ..... | 7,990 | 10,800 | ..... |
| **1918–19.** | | | | | | | | | | |
| 1 | 3,720 | 7,400 | 6,830 | ..... | 40,200 | 30,700 | 10,100 | 40,800 | 10,100 | 6,450 |
| 2 | 3,600 | 7,990 | 6,270 | ..... | 39,600 | 28,000 | 9,430 | 39,000 | 10,100 | 6,270 |
| 3 | 3,480 | 7,790 | 5,390 | ..... | 38,400 | 26,800 | 9,430 | 40,200 | 10,300 | 6,830 |
| 4 | 3,480 | 7,400 | 5,730 | ..... | 37,200 | 25,300 | 9,650 | 40,800 | 10,100 | 6,640 |
| 5 | 3,480 | 7,400 | 5,730 | ..... | 35,400 | 23,100 | 9,870 | 40,200 | 10,300 | 7,020 |
| 6 | 3,480 | 7,590 | 6,090 | ..... | 33,700 | 22,700 | 10,300 | 37,200 | 9,870 | 7,020 |
| 7 | 3,240 | 7,790 | 6,090 | ..... | 32,200 | 21,300 | 10,800 | 34,800 | 10,800 | 7,590 |
| 8 | 3,360 | 8,190 | 5,730 | ..... | 33,200 | 21,600 | 11,500 | 33,200 | 10,300 | 7,020 |
| 9 | 3,130 | 8,790 | 5,910 | ..... | 34,300 | 21,600 | 12,900 | 31,700 | 10,300 | 7,790 |
| 10 | 3,360 | 9,210 | 5,730 | ..... | 35,400 | 22,000 | 15,300 | 29,800 | 10,100 | 7,210 |
| 11 | 3,360 | 9,430 | ..... | ..... | 36,600 | 22,300 | 16,400 | 28,400 | 9,430 | 7,020 |
| 12 | 3,360 | 10,300 | ..... | ..... | 38,400 | 22,700 | 17,300 | 26,400 | 9,650 | 7,400 |
| 13 | 3,240 | 10,300 | ..... | ..... | 40,200 | 23,400 | 18,500 | 25,600 | 9,870 | 7,400 |
| 14 | 3,130 | 9,870 | ..... | ..... | 42,600 | 23,400 | 18,900 | 25,300 | 9,000 | 7,210 |
| 15 | 3,130 | 9,430 | ..... | 7,790 | 44,600 | 22,300 | 19,900 | 24,100 | 9,430 | 7,020 |
| 16 | 3,130 | 9,000 | ..... | 10,300 | 46,700 | 21,300 | 20,600 | 22,000 | 9,210 | 7,400 |
| 17 | 3,130 | 9,650 | ..... | 11,900 | 48,100 | 19,500 | 22,700 | 20,900 | 9,210 | 6,830 |
| 18 | 3,130 | 9,650 | ..... | 13,700 | 48,800 | 18,900 | 23,100 | 18,900 | 8,390 | 6,450 |
| 19 | 3,360 | 11,500 | ..... | 16,400 | 49,500 | 17,900 | 23,800 | 17,600 | 9,000 | 6,830 |
| 20 | 3,130 | 12,200 | ..... | 25,300 | 50,900 | 16,400 | 23,800 | 15,800 | 8,590 | 6,450 |
| 21 | 2,920 | 12,400 | ..... | 29,300 | 52,400 | 16,100 | 23,800 | 15,800 | 7,990 | 6,830 |
| 22 | 3,130 | 12,900 | ..... | 34,300 | 54,500 | 15,000 | 23,800 | 14,700 | 7,790 | 6,450 |
| 23 | 3,020 | 12,400 | ..... | 39,000 | 53,800 | 14,700 | 27,600 | 13,900 | 7,990 | 6,450 |
| 24 | 3,130 | 11,200 | ..... | 41,400 | 51,600 | 13,900 | 31,700 | 12,900 | 7,590 | 6,090 |
| 25 | 3,240 | 10,100 | ..... | 45,300 | 48,800 | 13,200 | 38,400 | 12,400 | 6,830 | 5,910 |
| 26 | 3,360 | 9,000 | ..... | 45,300 | 45,300 | 12,600 | 41,400 | 11,500 | 7,210 | 5,730 |
| 27 | 4,090 | 8,390 | ..... | 44,600 | 42,600 | 12,200 | 44,600 | 11,500 | 6,830 | 5,910 |
| 28 | 4,220 | 7,400 | ..... | 44,600 | 39,000 | 11,900 | 44,600 | 10,500 | 6,270 | 5,730 |
| 29 | 4,350 | 7,210 | ..... | 43,300 | 36,000 | 11,500 | 44,600 | 11,000 | 6,640 | 6,090 |
| 30 | 5,230 | 7,210 | ..... | 42,000 | 33,200 | 10,100 | 42,600 | 9,870 | 6,450 | 5,910 |
| 31 | 6,450 | ..... | ..... | 42,600 | ..... | 9,650 | ..... | 10,500 | 7,020 | ..... |

*Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the years ending Sept. 30, 1918–1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | |
| 1 | 6,090 | 7,030 | 4,350 | ..... | 49,500 | 24,600 | 16,700 | 33,000 | 18,300 | 7,850 |
| 2 | 6,640 | 6,640 | ..... | ..... | 46,700 | 24,200 | 15,800 | 35,300 | 17,300 | 7,640 |
| 3 | 7,640 | 7,230 | ..... | ..... | 44,600 | 23,900 | 16,100 | 36,800 | 16,100 | 8,060 |
| 4 | 7,430 | 7,430 | ..... | ..... | 40,800 | 23,200 | 17,600 | 37,800 | 14,900 | 8,280 |
| 5 | 7,430 | 6,830 | ..... | ..... | 38,400 | 21,800 | 19,200 | 37,800 | 14,300 | 8,060 |
| 6 | 7,430 | 6,640 | ..... | ..... | 36,800 | 21,500 | 19,900 | 37,800 | 13,400 | 8,060 |
| 7 | 7,230 | 6,090 | ..... | ..... | 34,000 | 21,200 | 20,500 | 37,800 | 12,600 | 7,640 |
| 8 | 6,640 | 5,730 | ..... | ..... | 32,200 | 19,500 | 21,200 | 37,300 | 12,000 | 7,430 |
| 9 | 7,230 | 6,090 | ..... | 5,230 | 31,300 | 18,300 | 21,500 | 36,800 | 11,200 | 7,640 |
| 10 | 7,030 | 6,450 | ..... | 5,230 | 29,200 | 17,600 | 21,500 | 36,300 | 10,400 | 7,430 |
| 11 | 7,030 | 6,830 | ..... | 4,920 | 27,200 | 18,300 | 21,800 | 35,300 | 10,200 | 8,060 |
| 12 | 7,030 | 6,830 | ..... | 5,560 | 26,000 | 19,900 | 22,900 | 34,400 | 9,910 | 8,500 |
| 13 | 7,030 | 5,390 | ..... | 5,910 | 25,000 | 21,500 | 22,900 | 34,000 | 10,200 | 8,280 |
| 14 | 7,030 | 4,220 | ..... | 5,910 | 23,900 | 21,500 | 23,900 | 33,000 | 10,200 | 8,720 |
| 15 | 6,830 | 4,350 | ..... | 5,910 | 22,900 | 21,800 | 25,700 | 32,600 | 10,200 | 8,280 |
| 16 | 6,830 | 4,630 | ..... | 9,660 | 21,800 | 21,800 | 27,200 | 31,700 | 10,200 | 7,850 |
| 17 | 6,640 | 5,070 | ..... | 14,300 | 20,500 | 22,500 | 29,600 | 30,800 | 10,200 | 8,280 |
| 18 | 6,640 | 5,910 | ..... | 16,400 | 18,900 | 22,200 | 31,700 | 30,400 | 9,910 | 8,060 |
| 19 | 6,640 | 6,640 | ..... | 18,600 | 18,600 | 21,800 | 32,600 | 30,400 | 9,180 | 7,850 |
| 20 | 6,640 | 7,030 | ..... | 18,900 | 18,300 | 21,500 | 32,200 | 30,000 | 9,420 | 8,060 |
| 21 | 6,830 | 7,430 | ..... | 17,900 | 18,300 | 20,800 | 32,200 | 29,200 | 9,420 | 8,950 |
| 22 | 6,640 | 8,060 | ..... | 18,300 | 17,900 | 19,900 | 31,300 | 28,800 | 9,420 | 8,060 |
| 23 | 6,830 | 8,950 | ..... | 20,800 | 17,900 | 19,500 | 30,400 | 28,400 | 8,950 | 8,280 |
| 24 | 6,640 | 9,180 | ..... | 30,800 | 18,600 | 19,500 | 29,200 | 27,600 | 8,950 | 8,280 |
| 25 | 7,030 | 8,280 | ..... | 35,800 | 19,500 | 19,200 | 28,000 | 26,800 | 8,720 | 8,280 |
| 26 | 7,030 | 7,850 | ..... | 46,000 | 20,500 | 18,900 | 26,400 | 25,700 | 8,280 | 8,060 |
| 27 | 7,030 | 8,280 | ..... | 50,900 | 22,200 | 17,900 | 25,700 | 24,600 | 8,500 | 7,850 |
| 28 | 6,830 | 5,070 | ..... | 51,600 | 22,900 | 17,900 | 27,600 | 23,600 | 8,280 | 8,060 |
| 29 | 6,830 | 4,350 | ..... | 53,100 | 23,600 | 17,600 | 28,800 | 22,200 | 8,280 | 8,500 |
| 30 | 6,640 | 4,350 | ..... | 52,400 | 24,200 | 16,400 | 30,000 | 20,500 | 8,060 | 8,500 |
| 31 | 7,030 | ..... | ..... | 51,600 | ..... | 16,100 | ..... | 19,900 | 8,060 | ..... |

*Monthly discharge of Mississippi River at St. Paul, Minn., for the years ending Sept. 30, 1918–1920.*

[Drainage area, 35,700 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1917–18. | | | | | |
| October | 7,790 | 6,090 | 6,910 | 0.194 | 0.22 |
| November | 6,640 | 4,490 | 5,900 | .165 | .18 |
| December 1–6 | 4,490 | 2,630 | 3,360 | .094 | .02 |
| March 18–31 | 20,900 | 7,590 | 15,600 | .437 | .23 |
| April | 11,700 | 5,560 | 7,660 | .215 | .24 |
| May | 15,500 | 6,090 | 9,760 | .273 | .31 |
| June | 17,600 | 6,830 | 11,700 | .328 | .37 |
| July | 7,990 | 4,920 | 6,010 | .168 | .19 |
| August | 14,700 | 5,070 | 8,600 | .241 | .28 |
| September | 9,870 | 3,360 | 5,500 | .154 | .17 |
| 1918–19. | | | | | |
| October | 6,450 | 2,920 | 3,530 | .099 | .11 |
| November | 12,900 | 7,210 | 9,300 | .261 | .29 |
| December 1–10 | 6,830 | 5,390 | 5,950 | .167 | .06 |
| March 15–31 | 45,300 | 7,790 | 31,600 | .885 | .56 |
| April | 54,500 | 32,200 | 42,100 | 1.18 | 1.32 |
| May | 30,700 | 9,650 | 19,100 | .535 | .62 |
| June | 44,600 | 9,430 | 22,600 | .633 | .71 |
| July | 40,800 | 9,870 | 23,500 | .658 | .76 |
| August | 10,800 | 6,270 | 8,800 | .247 | .28 |
| September | 7,790 | 5,730 | 6,700 | .188 | .21 |
| 1919–20. | | | | | |
| October | 7,640 | 6,090 | 6,920 | .194 | .22 |
| November | 9,180 | 4,220 | 6,500 | .182 | .20 |
| March 9–31 | 53,100 | 4,920 | 23,700 | .664 | .57 |
| April | 49,500 | 17,900 | 27,100 | .759 | .85 |
| May | 24,600 | 16,100 | 20,400 | .571 | .66 |
| June | 32,600 | 15,800 | 25,000 | .700 | .78 |
| July | 37,800 | 19,900 | 31,200 | .874 | 1.01 |
| August | 18,300 | 8,060 | 10,800 | .303 | .35 |
| September | 8,950 | 7,430 | 8,100 | .227 | .25 |

### MINNESOTA RIVER NEAR MONTEVIDEO, MINN.

LOCATION.—In sec. 17, T. 117 N., R. 40 W., at highway bridge 1 mile south of Montevideo, Chippewa County, and 500 feet below mouth of Chippewa River.

DRAINAGE AREA.—6,300 square miles.

RECORDS AVAILABLE.—July 22, 1909, to September 30, 1920.

GAGE.—Chain gage attached to upstream handrail of bridge, near left bank; read by Esther Hendricks. Datum of gage lowered 2 feet September 16, 1909, and 1 foot more July 29, 1910, to avoid negative readings. All gage heights referred to latest datum.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and sand; practically permanent. There is a slight rapids just below gage, but the control section is not well defined. The banks are of medium height, and will be overflowed at a stage of about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, about 18.85 feet June 25 (discharge, about 22,000 second-feet); gage height furnished by A. F. Meyer, consulting engineer, Minneapolis, Minn.; minimum open-water stage, 1.82 feet October 5 (discharge, about 52 second-feet).

Maximum stage recorded during year ending September 30, 1920, 15.05 feet July 13 (discharge, 8,930 second-feet); minimum stage recorded, 3.06 feet October 1 and 12 and November 5 (discharge, 207 second-feet).

1909–1920: Maximum stage recorded, about 18.85 feet June 25, 1919 (discharge, about 22,000 second-feet); minimum discharge recorded, 6.8 second-feet February 9, 1912, by current-meter measurement.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No regulation on Minnesota River above station. Regulation of Chippewa River at plant of Chippewa Milling Co., in Montevideo, produces a slight fluctuation in stage of Minnesota River at gage.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 21, 1918, to March 16, 1919, and November 24, 1919, to March 16, 1920. One rating curve used; fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except during periods of ice effect for which no discharge computations were made, and except for period June 23 to July 3, 1919, when gage was not read because of flooded banks, for which period daily discharge was ascertained from field investigations and studies by Adolph F. Meyer, consulting engineer, Minneapolis, Minn. Records good for 1919; fair for 1920.

*Discharge measurements of Minnesota River near Montevideo, Minn., during the years ending Sept. 30, 1919 and 1920.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| 1919. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* |
| Apr. 25..... | 8.57 | 1,930 | June 24..... | 14.05 | 5,850 | Sept. 8..... | 5.36 | 694 |

*Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | |
| 1 | 70 | 138 | 198 | ..... | 2,280 | 1,610 | 731 | 10,200 | 1,200 | 338 |
| 2 | 62 | 106 | 216 | ..... | 2,180 | 1,530 | 759 | 9,000 | 1,160 | 316 |
| 3 | 70 | 111 | 207 | ..... | 2,140 | 1,530 | 759 | 8,200 | 1,100 | 316 |
| 4 | 59 | 116 | 234 | ..... | 2,050 | 1,530 | 906 | 6,890 | 1,100 | 316 |
| 5 | 52 | 130 | 216 | ..... | 1,960 | 1,530 | 967 | 5,810 | 1,030 | 316 |
| 6 | 67 | 116 | 216 | ..... | 1,920 | 1,530 | 1,060 | 5,050 | 998 | 316 |
| 7 | 67 | 154 | 207 | ..... | 1,870 | 1,610 | 1,160 | 4,300 | 967 | 316 |
| 8 | 59 | 162 | 216 | ..... | 1,820 | 1,610 | 1,200 | 4,110 | 906 | 316 |
| 9 | 62 | 180 | 225 | ..... | 1,920 | 1,610 | 1,270 | 3,950 | 846 | 316 |
| 10 | 68 | 198 | 225 | ..... | 1,960 | 1,610 | 1,230 | 3,880 | 817 | 316 |
| 11 | 77 | 162 | 225 | ..... | 2,000 | 1,570 | 1,270 | 3,690 | 759 | 316 |
| 12 | 70 | 171 | 216 | ..... | 2,050 | 1,490 | 1,300 | 3,520 | 788 | 316 |
| 13 | 80 | 189 | 225 | ..... | 1,960 | 1,450 | 1,300 | 3,570 | 731 | 274 |
| 14 | 71 | 162 | 244 | ..... | 1,960 | 1,380 | 1,300 | 3,130 | 731 | 274 |
| 15 | 65 | 138 | 234 | ..... | 2,000 | 1,340 | 1,450 | 2,910 | 731 | 274 |
| 16 | 75 | 138 | 216 | ..... | 2,050 | 1,300 | 1,610 | 2,810 | 675 | 274 |
| 17 | 80 | 207 | 216 | 2,100 | 2,100 | 1,270 | 1,920 | 2,660 | 675 | 274 |
| 18 | 78 | 274 | 216 | 2,140 | 2,100 | 998 | 1,960 | 2,510 | 621 | 234 |
| 19 | 68 | 244 | 216 | 2,410 | 2,050 | 998 | 2,050 | 2,320 | 594 | 216 |
| 20 | 70 | 216 | 216 | 2,050 | 2,100 | 1,030 | 2,230 | 2,140 | 542 | 234 |
| 21 | 88 | 234 | ..... | 2,050 | 2,100 | 1,100 | 2,410 | 2,100 | 516 | 198 |
| 22 | 75 | 207 | ..... | 2,230 | 2,050 | 1,100 | 2,710 | 1,920 | 462 | 254 |
| 23 | 84 | 216 | ..... | 2,510 | 2,050 | 1,030 | 7,000 | 1,780 | 462 | 254 |
| 24 | 84 | 216 | ..... | 2,610 | 2,050 | 1,030 | 13,000 | 1,740 | 462 | 254 |
| 25 | 99 | 234 | ..... | 2,660 | 2,000 | 967 | 22,000 | 1,610 | 462 | 244 |
| 26 | 86 | 254 | ..... | 2,560 | 1,920 | 967 | 19,000 | 1,530 | 462 | 225 |
| 27 | 104 | 234 | ..... | 2,510 | 1,870 | 906 | 16,000 | 1,380 | 436 | 207 |
| 28 | 123 | 216 | ..... | 2,510 | 1,820 | 846 | 14,500 | 1,380 | 386 | 207 |
| 29 | 130 | 234 | ..... | 2,410 | 1,740 | 817 | 13,000 | 1,300 | 362 | 216 |
| 30 | 130 | 207 | ..... | 2,410 | 1,650 | 759 | 11,500 | 1,230 | 362 | 216 |
| 31 | 130 | ..... | ..... | 2,320 | ..... | 731 | ..... | 1,230 | 362 | ..... |
| 1919–20. | | | | | | | | | | |
| 1 | 207 | 244 | ..... | ..... | 3,130 | 1,340 | 1,300 | 4,760 | 2,460 | 647 |
| 2 | 216 | 234 | ..... | ..... | 3,080 | 1,300 | 1,650 | 4,760 | 2,320 | 619 |
| 3 | 225 | 234 | ..... | ..... | 3,180 | 1,270 | 1,870 | 4,760 | 2,100 | 592 |
| 4 | 234 | 216 | ..... | ..... | 2,320 | 1,300 | 2,050 | 4,760 | 2,000 | 675 |
| 5 | 244 | 207 | ..... | ..... | 2,460 | 1,300 | 2,320 | 4,760 | 1,960 | 703 |
| 6 | 244 | 216 | ..... | ..... | 2,560 | 1,230 | 2,460 | 5,050 | 1,820 | 731 |
| 7 | 254 | 225 | ..... | ..... | 2,410 | 1,230 | 2,510 | 5,810 | 1,780 | 731 |
| 8 | 254 | 244 | ..... | ..... | 2,280 | 1,200 | 2,710 | 8,220 | 1,570 | 731 |
| 9 | 234 | 254 | ..... | ..... | 2,180 | 1,100 | 2,810 | 8,930 | 1,490 | 703 |
| 10 | 254 | 274 | ..... | ..... | 2,140 | 1,100 | 2,860 | 8,930 | 1,380 | 703 |
| 11 | 244 | 294 | ..... | ..... | 2,000 | 1,160 | 2,910 | 8,570 | 1,340 | 731 |
| 12 | 207 | 338 | ..... | ..... | 1,870 | 1,230 | 2,960 | 8,930 | 1,270 | 731 |
| 13 | 216 | 362 | ..... | ..... | 1,740 | 1,380 | 3,020 | 8,930 | 1,160 | 731 |
| 14 | 216 | 386 | ..... | ..... | 1,690 | 1,410 | 3,080 | 8,930 | 1,100 | 731 |
| 15 | 216 | 410 | ..... | ..... | 1,610 | 1,380 | 3,240 | 8,220 | 1,060 | 647 |
| 16 | 225 | 436 | ..... | ..... | 1,530 | 1,300 | 3,300 | 7,540 | 998 | 619 |
| 17 | 234 | 436 | ..... | 876 | 1,450 | 1,300 | 3,300 | 6,890 | 967 | 619 |
| 18 | 264 | 436 | ..... | 917 | 1,380 | 1,300 | 3,350 | 6,310 | 876 | 592 |
| 19 | 254 | 436 | ..... | 958 | 1,340 | 1,300 | 3,460 | 5,810 | 817 | 540 |
| 20 | 234 | 436 | ..... | 998 | 1,300 | 1,270 | 3,690 | 5,390 | 846 | 514 |
| 21 | 216 | 410 | ..... | 1,300 | 1,270 | 1,230 | 4,510 | 5,210 | 817 | 514 |
| 22 | 234 | 410 | ..... | 1,690 | 1,270 | 1,230 | 5,810 | 4,760 | 788 | 514 |
| 23 | 234 | 410 | ..... | 2,280 | 1,270 | 1,160 | 6,050 | 4,400 | 731 | 488 |
| 24 | 254 | ..... | ..... | 2,280 | 1,270 | 1,100 | 6,310 | 4,110 | 675 | 514 |
| 25 | 274 | ..... | ..... | 2,280 | 1,340 | 1,030 | 5,590 | 3,950 | 647 | 488 |
| 26 | 234 | ..... | ..... | 2,760 | 1,450 | 1,030 | 5,390 | 3,570 | 592 | 619 |
| 27 | 216 | ..... | ..... | 2,810 | 1,450 | 1,060 | 5,050 | 3,350 | 566 | 731 |
| 28 | 216 | ..... | ..... | 2,960 | 1,450 | 998 | 4,900 | 3,180 | 566 | 759 |
| 29 | 225 | ..... | ..... | 3,080 | 1,450 | 967 | 5,050 | 2,960 | 619 | 759 |
| 30 | 234 | ..... | ..... | 3,130 | 1,380 | 967 | 5,050 | 2,860 | 675 | 703 |
| 31 | 244 | ..... | ..... | 3,130 | ..... | 967 | ..... | 2,660 | 675 | ..... |

*Monthly discharge of Minnesota River near Montevideo, Minn., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 6,300 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 130 | 52 | 80.7 | 0.013 | 0.01 |
| November | 274 | 106 | 185 | .029 | .03 |
| December 1–20 | 244 | 198 | 219 | .035 | .03 |
| March 17–31 | 2,660 | 2,050 | 2,370 | .376 | .21 |
| April | 2,280 | 1,650 | 1,990 | .316 | .35 |
| May | 1,610 | 731 | 1,250 | .198 | .23 |
| June | 22,000 | 731 | 4,920 | .781 | .87 |
| July | 10,200 | 1,230 | 3,480 | .552 | .64 |
| August | 1,200 | 362 | 700 | .111 | .13 |
| September | 338 | 207 | 271 | .043 | .05 |
| 1919–20. | | | | | |
| October | 274 | 207 | 234 | .037 | .04 |
| November 1–23 | 436 | 207 | 328 | .052 | .04 |
| March 17–31 | 3,130 | 876 | 2,100 | .333 | .19 |
| April | 3,180 | 1,270 | 1,840 | .292 | .33 |
| May | 1,410 | 967 | 1,200 | .190 | .22 |
| June | 6,310 | 1,300 | 3,620 | .575 | .64 |
| July | 8,930 | 2,660 | 5,720 | .908 | 1.05 |
| August | 2,460 | 566 | 1,180 | .187 | .22 |
| September | 759 | 488 | 646 | .103 | .11 |

### MINNESOTA RIVER NEAR MANKATO, MINN.

LOCATION.—In sec. 14, T. 108 N., R. 27 W., at Sibley Park, 2 miles above center of Mankato, Blue Earth County, and 1,000 feet below mouth of Blue Earth River.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—May 20, 1903, to September 30, 1920.

GAGE.—Chain gage on right bank of river, about 1,000 feet below mouth of Blue Earth River; read by Clarence Staley, observer for United States Weather Bureau. The gage support is a fairly substantial cantilever structure, supported by two heavy posts resting in concrete footings; settling somewhat; constructed and maintained by the U. S. Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from new concrete highway bridge in center of Mankato 2 miles below gage, by wading a short distance below gage, or at extreme high stages, by boat near gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel; shifts during high stages. Banks moderately high and not subject to overflow, except at stages above gage height of 15 feet. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1918, 10.9 feet August 24 (discharge, 14,500 second-feet); minimum stage recorded, 1.2 feet October 10, 11, 15–17, 25, 26, 31, November 1–3, 11–14, 20–24, and December 4–10 (discharge, 420 second-feet).

Maximum stage recorded during year ending September 30, 1919, 18.9 feet June 21 (discharge, 35,800 second-feet); minimum stage recorded, 1.2 feet October 23–28 (discharge, 720 second-feet).

Maximum stage recorded during year ending September 30, 1920, 12.0 feet July 18 (discharge, 19,600 second-feet); minimum stage recorded, 1.2 feet October 22, 25, and 26 (discharge, 660 second-feet).

1903–1920: Maximum stage recorded, 21.2 feet June 26, 1908 (discharge, 43,800 second-feet); minimum stage recorded, 0.5 foot August 31 to September 2, 1911 (discharge, 89 second-feet).

The highest known stage of this river occurred in 1881, and is shown in Mankato by a well-marked line, about 27 feet above zero of present gage (discharge, estimated 65,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The nearest dam on Minnesota River is at Minnesota Falls, 140 miles upstream. A dam on Blue Earth River at Rapidan, a few miles above the mouth, controls the flow of that river, which is about 20 per cent of that at the Mankato station, and produces considerable daily fluctuation at the gage, amounting at times to over 1 foot.

ACCURACY.—Stage-discharge relation not permanent; affected by ice January 1 to March 18, 1918, December 11, 1918, to March 13, 1919, and December 5, 1919, to March 22, 1920. Two rating curves used, one from October 1, 1917, to March 19, 1918, and one from March 20, 1918, to September 30, 1920; both curves poorly defined. Gage read to tenths once daily. This gage reading does not represent accurately the mean daily stage on account of fluctuation caused by artificial regulation. Daily discharge ascertained by applying daily gage height to rating table except for periods when stage-discharge relation was affected by ice for which no computations of discharge were made. Indirect method for shifting control used October 1, 1919, to September 30, 1920. Records probably poor.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Minnesota River near Mankato, Minn., during the years ending Sept. 30, 1919 and 1920.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| 1918. | *Feet.* | *Sec.-ft.* | 1919. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* |
| Nov. 13 | 5.77 | 5,000 | Apr. 28 | 10.62 | 14,000 | May 13 | 5.01 | 4,950 |
| | | | Oct. 22 | 1.12 | 621 | 15 | 5.97 | 6,880 |
| | | | | | | June 25 | 6.90 | 8,080 |
| | | | | | | Sept. 6 | 2.09 | 1,390 |

*Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for the years ending Sept. 30, 1918–1920.*

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1917–18. | | | | | | | | | | |
| 1 | 470 | 420 | 470 | ..... | 3,680 | 1,320 | 6,550 | 1,510 | 3,460 | 3,460 |
| 2 | 520 | 420 | 470 | ..... | 3,570 | 1,320 | 6,550 | 1,440 | 3,240 | 3,460 |
| 3 | 520 | 420 | 470 | ..... | 3,570 | 1,260 | 6,550 | 1,440 | 2,840 | 3,680 |
| 4 | 520 | 470 | 420 | ..... | 3,460 | 1,380 | 6,710 | 1,440 | 2,650 | 3,460 |
| 5 | 470 | 470 | 420 | ..... | 3,460 | 1,440 | 6,230 | 1,380 | 2,290 | 3,240 |
| 6 | 470 | 470 | 420 | ..... | 3,460 | 1,440 | 5,330 | 1,380 | 2,110 | 3,140 |
| 7 | 470 | 470 | 420 | ..... | 3,140 | 1,510 | 4,780 | 1,380 | 2,200 | 3,040 |
| 8 | 470 | 470 | 420 | ..... | 2,940 | 1,580 | 4,390 | 1,320 | 2,650 | 2,840 |
| 9 | 470 | 470 | 420 | ..... | 2,740 | 1,650 | 4,270 | 1,320 | 2,650 | 2,840 |
| 10 | 420 | 470 | 420 | ..... | 2,650 | 1,650 | 4,030 | 1,320 | 2,840 | 2,740 |
| 11 | 420 | 420 | 470 | ..... | 2,470 | 1,650 | 3,680 | 1,320 | 2,840 | 2,650 |
| 12 | 470 | 420 | 470 | ..... | 2,380 | 1,580 | 3,460 | 1,320 | 2,940 | 2,650 |
| 13 | 470 | 420 | 470 | ..... | 2,290 | 1,580 | 3,240 | 1,320 | 2,940 | 2,290 |
| 14 | 470 | 420 | 470 | ..... | 2,200 | 1,870 | 2,650 | 1,260 | 2,840 | 2,290 |
| 15 | 420 | 470 | 470 | ..... | 2,110 | 2,030 | 2,560 | 1,260 | 2,740 | 2,200 |
| 16 | 420 | 470 | 470 | ..... | 2,110 | 2,110 | 2,560 | 1,380 | 3,140 | 2,110 |
| 17 | 420 | 470 | 470 | ..... | 2,030 | 2,200 | 1,950 | 1,440 | 5,920 | 2,110 |
| 18 | 570 | 470 | 470 | ..... | 1,650 | 2,290 | 2,110 | 1,510 | 9,470 | 2,200 |
| 19 | 570 | 470 | 520 | 12,400 | 1,650 | 2,290 | 2,290 | 1,440 | 10,500 | 2,200 |
| 20 | 520 | 420 | 520 | 14,100 | 1,580 | 2,290 | 2,290 | 1,440 | 10,700 | 2,110 |
| 21 | 470 | 420 | 470 | 13,400 | 1,580 | 2,380 | 2,200 | 1,510 | 9,880 | 1,950 |
| 22 | 470 | 420 | 470 | 12,000 | 1,510 | 2,560 | 2,110 | 1,510 | 12,000 | 1,950 |
| 23 | 470 | 420 | 470 | 10,500 | 1,510 | 2,560 | 2,200 | 1,440 | 14,300 | 1,870 |
| 24 | 470 | 420 | 470 | 7,750 | 1,440 | 3,680 | 2,200 | 1,440 | 14,500 | 1,870 |
| 25 | 420 | 470 | 470 | 6,880 | 1,440 | 4,150 | 2,110 | 1,380 | 12,000 | 1,790 |
| 26 | 420 | 470 | 470 | 6,230 | 1,440 | 4,150 | 2,110 | 1,440 | 10,500 | 1,790 |
| 27 | 470 | 470 | 470 | 6,070 | 1,380 | 4,390 | 2,110 | 1,510 | 9,070 | 1,720 |
| 28 | 470 | 470 | 470 | 4,910 | 1,380 | 4,650 | 1,790 | 2,470 | 8,490 | 1,720 |
| 29 | 470 | 470 | 470 | 4,780 | 1,380 | 5,050 | 1,650 | 3,570 | 7,390 | 1,720 |
| 30 | 470 | 470 | 470 | 4,030 | 1,380 | 5,470 | 1,510 | 3,790 | 6,710 | 1,720 |
| 31 | 420 | ..... | 470 | 3,910 | ..... | 6,390 | ..... | 3,570 | 4,030 | ..... |

*Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for the years ending Sept. 30, 1918–1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | |
| 1 | 1,650 | 3,680 | 2,840 | ..... | 16,200 | 9,880 | 2,740 | 29,600 | 3,350 | 1,200 |
| 2 | 1,580 | 4,030 | 2,740 | ..... | 14,500 | 8,490 | 2,740 | 25,200 | 3,140 | 1,080 |
| 3 | 1,320 | 4,030 | 2,650 | ..... | 14,300 | 7,220 | 2,940 | 22,900 | 3,040 | 1,080 |
| 4 | 1,200 | 4,030 | 2,470 | ..... | 14,300 | 6,880 | 2,940 | 23,400 | 2,740 | 1,020 |
| 5 | 1,140 | 3,910 | 2,470 | ..... | 13,600 | 6,390 | 3,140 | 22,100 | 2,650 | 1,080 |
| 6 | 1,140 | 3,790 | 2,380 | ..... | 12,900 | 6,710 | 4,270 | 19,400 | 2,650 | 1,140 |
| 7 | 1,140 | 3,910 | 2,290 | ..... | 12,000 | 6,550 | 5,190 | 19,100 | 2,560 | 1,140 |
| 8 | 1,020 | 4,030 | 2,030 | ..... | 12,700 | 8,110 | 5,190 | 17,200 | 2,650 | 1,080 |
| 9 | 1,020 | 4,030 | 2,030 | ..... | 12,700 | 8,490 | 5,770 | 15,700 | 2,470 | 1,200 |
| 10 | 1,020 | 4,030 | 1,870 | ..... | 16,000 | 8,490 | 6,230 | 14,800 | 2,470 | 1,380 |
| 11 | 960 | 4,030 | ..... | ..... | 19,600 | 8,110 | 6,390 | 14,300 | 2,380 | 1,380 |
| 12 | 960 | 3,910 | ..... | ..... | 21,800 | 7,930 | 7,570 | 13,800 | 2,200 | 1,440 |
| 13 | 960 | 4,520 | ..... | ..... | 22,100 | 6,550 | 10,700 | 13,200 | 2,470 | 1,380 |
| 14 | 900 | 4,390 | ..... | 14,100 | 21,800 | 6,230 | 11,200 | 12,500 | 2,560 | 1,380 |
| 15 | 900 | 4,390 | ..... | 15,700 | 24,700 | 6,230 | 11,800 | 11,800 | 2,380 | 1,440 |
| 16 | 780 | 4,520 | ..... | 16,700 | 25,200 | 6,230 | 13,200 | 11,400 | 2,200 | 1,440 |
| 17 | 780 | 4,650 | ..... | 18,400 | 26,800 | 5,190 | 16,000 | 11,200 | 2,200 | 1,380 |
| 18 | 780 | 4,650 | ..... | 21,800 | 29,600 | 5,190 | 16,700 | 10,500 | 2,110 | 1,380 |
| 19 | 780 | 4,650 | ..... | 23,900 | 30,200 | 4,910 | 19,100 | 9,880 | 1,950 | 1,440 |
| 20 | 780 | 5,920 | ..... | 23,400 | 30,200 | 4,520 | 32,200 | 8,300 | 1,950 | 1,380 |
| 21 | 780 | 6,880 | ..... | 23,400 | 29,600 | 4,390 | 35,800 | 8,490 | 1,870 | 1,320 |
| 22 | 780 | 7,220 | ..... | 21,400 | 29,600 | 4,270 | 33,400 | 7,750 | 1,870 | 1,320 |
| 23 | 720 | 7,220 | ..... | 21,100 | 24,700 | 3,910 | 31,900 | 5,620 | 1,790 | 1,320 |
| 24 | 720 | 6,390 | ..... | 20,600 | 21,800 | 4,030 | 30,200 | 4,650 | 1,790 | 1,260 |
| 25 | 720 | 5,620 | ..... | 20,100 | 17,200 | 3,570 | 27,700 | 4,150 | 1,650 | 1,080 |
| 26 | 720 | 4,030 | ..... | 19,100 | 15,500 | 3,570 | 25,000 | 3,680 | 1,440 | 960 |
| 27 | 720 | 3,700 | ..... | 19,400 | 14,500 | 3,460 | 22,900 | 3,570 | 1,320 | 840 |
| 28 | 720 | 3,570 | ..... | 19,400 | 14,500 | 3,240 | 22,900 | 3,570 | 1,380 | 840 |
| 29 | 2,650 | 3,240 | ..... | 19,100 | 12,500 | 3,040 | 24,200 | 3,350 | 1,380 | 840 |
| 30 | 3,240 | 2,940 | ..... | 18,100 | 11,400 | 2,840 | 28,000 | 3,140 | 1,320 | 840 |
| 31 | 3,680 | ..... | ..... | 17,200 | ..... | 2,650 | ..... | 3,140 | 1,320 | ..... |
| 1919–20. | | | | | | | | | | |
| 1 | 840 | 720 | 1,080 | ..... | 12,700 | 7,930 | 5,050 | 8,110 | 6,390 | 1,380 |
| 2 | 780 | 720 | 1,020 | ..... | 12,900 | 7,220 | 4,910 | 8,110 | 6,070 | 1,320 |
| 3 | 780 | 720 | 1,020 | ..... | 12,700 | 6,390 | 4,910 | 8,300 | 5,620 | 1,320 |
| 4 | 780 | 720 | 960 | ..... | 12,500 | 6,230 | 4,780 | 8,300 | 4,910 | 1,320 |
| 5 | 720 | 780 | ..... | ..... | 12,000 | 6,070 | 4,390 | 8,680 | 4,650 | 1,380 |
| 6 | 720 | 780 | ..... | ..... | 11,600 | 5,920 | 4,390 | 10,100 | 4,030 | 1,320 |
| 7 | 720 | 780 | ..... | ..... | 11,600 | 5,620 | 4,270 | 12,200 | 4,030 | 1,320 |
| 8 | 780 | 780 | ..... | ..... | 11,400 | 5,330 | 4,030 | 15,200 | 3,570 | 1,320 |
| 9 | 780 | 780 | ..... | ..... | 11,200 | 5,190 | 4,270 | 16,200 | 3,460 | 1,380 |
| 10 | 720 | 840 | ..... | ..... | 10,300 | 5,330 | 4,270 | 16,700 | 3,350 | 1,510 |
| 11 | 720 | 840 | ..... | ..... | 9,880 | 5,470 | 4,390 | 16,900 | 3,140 | 1,580 |
| 12 | 720 | 840 | ..... | ..... | 9,470 | 5,620 | 4,390 | 17,200 | 3,040 | 1,580 |
| 13 | 720 | 900 | ..... | ..... | 9,470 | 4,910 | 4,520 | 16,200 | 2,940 | 1,440 |
| 14 | 720 | 960 | ..... | ..... | 9,270 | 5,050 | 4,650 | 16,700 | 2,840 | 1,380 |
| 15 | 780 | 960 | ..... | ..... | 8,870 | 5,770 | 4,910 | 18,400 | 2,650 | 1,380 |
| 16 | 780 | 1,020 | ..... | ..... | 8,300 | 5,920 | 6,070 | 19,100 | 2,380 | 1,260 |
| 17 | 780 | 1,020 | ..... | ..... | 7,390 | 5,920 | 8,680 | 19,400 | 2,200 | 1,260 |
| 18 | 780 | 1,020 | ..... | ..... | 6,390 | 6,070 | 8,490 | 19,600 | 2,200 | 1,260 |
| 19 | 840 | 1,020 | ..... | ..... | 6,230 | 6,230 | 10,700 | 18,800 | 2,110 | 1,200 |
| 20 | 840 | 960 | ..... | ..... | 5,620 | 6,390 | 10,900 | 18,400 | 2,110 | 1,200 |
| 21 | 780 | 1,020 | ..... | ..... | 5,470 | 6,390 | 10,100 | 16,900 | 2,030 | 1,200 |
| 22 | 660 | 1,080 | ..... | ..... | 5,470 | 6,230 | 9,880 | 16,400 | 1,790 | 1,140 |
| 23 | 720 | 1,080 | ..... | 11,800 | 5,470 | 6,070 | 9,270 | 14,800 | 1,650 | 1,140 |
| 24 | 720 | 1,080 | ..... | 11,600 | 5,620 | 6,070 | 8,680 | 13,600 | 1,510 | 1,260 |
| 25 | 660 | 1,020 | ..... | 12,500 | 5,770 | 5,770 | 8,110 | 12,000 | 1,580 | 1,200 |
| 26 | 660 | 1,020 | ..... | 14,100 | 7,570 | 5,920 | 7,390 | 10,300 | 1,510 | 1,200 |
| 27 | 720 | 1,080 | ..... | 14,300 | 6,230 | 5,920 | 7,220 | 10,100 | 1,440 | 1,140 |
| 28 | 720 | 1,080 | ..... | 13,800 | 6,710 | 5,620 | 6,880 | 9,670 | 1,380 | 1,140 |
| 29 | 720 | 1,080 | ..... | 13,400 | 7,930 | 5,330 | 7,390 | 9,070 | 1,380 | 1,140 |
| 30 | 780 | 1,080 | ..... | 12,900 | 8,300 | 5,190 | 7,930 | 8,110 | 1,440 | 1,140 |
| 31 | 780 | ..... | ..... | 12,700 | ..... | 5,050 | ..... | 7,750 | 1,440 | ..... |

*Monthly discharge of Minnesota River near Mankato, Minn., for the years ending Sept. 30, 1918–1920.*

[Drainage area, 14,600 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1917–18. | | | | | |
| October | 570 | 420 | 470 | 0.032 | 0.04 |
| November | 470 | 420 | 450 | .031 | .03 |
| December | 520 | 420 | 462 | .032 | .04 |
| March 19–31 | 14,100 | 3,910 | 8,230 | .564 | .27 |
| April | 3,680 | 1,380 | 2,250 | .154 | .17 |
| May | 6,390 | 1,260 | 2,580 | .177 | .20 |
| June | 6,710 | 1,510 | 3,410 | .234 | .26 |
| July | 3,790 | 1,260 | 1,650 | .113 | .13 |
| August | 14,500 | 2,110 | 6,120 | .419 | .48 |
| September | 3,680 | 1,720 | 2,430 | .166 | .19 |
| 1918–19. | | | | | |
| October | 3,680 | 720 | 1,170 | .080 | .09 |
| November | 7,220 | 2,940 | 4,530 | .310 | .35 |
| December 1–10 | 2,840 | 1,870 | 2,380 | .163 | .06 |
| March 14–31 | 23,900 | 14,100 | 19,600 | 1.34 | .90 |
| April | 30,200 | 11,400 | 19,400 | 1.33 | 1.48 |
| May | 9,880 | 2,650 | 5,720 | .39 | .45 |
| June | 35,800 | 2,740 | 15,600 | 1.07 | 1.19 |
| July | 29,600 | 3,140 | 12,200 | .836 | .96 |
| August | 3,350 | 1,320 | 2,170 | .149 | .17 |
| September | 1,440 | 840 | 1,200 | .082 | .09 |
| 1919–20. | | | | | |
| October | 840 | 660 | 749 | .051 | .06 |
| November | 1,080 | 720 | 926 | .063 | .07 |
| December 1–4 | 1,080 | 930 | 1,020 | .070 | .01 |
| March 23–31 | 14,300 | 11,600 | 13,000 | .890 | .30 |
| April | 12,900 | 5,470 | 8,810 | .603 | .67 |
| May | 7,930 | 4,910 | 5,880 | .403 | .46 |
| June | 10,900 | 4,030 | 6,530 | .447 | .50 |
| July | 19,600 | 7,730 | 13,600 | .932 | 1.07 |
| August | 6,390 | 1,380 | 2,870 | .197 | .23 |
| September | 1,580 | 1,140 | 1,290 | .088 | .10 |

### ST. CROIX RIVER AT SWISS, WIS.

LOCATION.—In sec. 33, T. 42 N., R. 15 W., at highway bridge near post office of Swiss, Burnett County, 2 miles above point where St. Croix River becomes boundary line between Wisconsin and Minnesota, and 10 miles northeast of Danbury, Minn., on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters from left 3½ miles above station.

DRAINAGE AREA.—1,550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 13, 1914, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge May 16, 1918; read by Capt. Richard Goldschmidt. Prior to that date a cast-iron staff gage bolted to concrete pier at left end of bridge was used. Both gages at same datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; smooth. Growth of aquatic plants during summer may cause a small amount of backwater at gage. Left bank high and not subject to overflow; right bank of medium height and may possibly be overflowed during extremely high water.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year ending September 30, 1919, 3,330 second-feet April 11; minimum discharge, estimated 740 second-feet February 2 (stage-discharge relation affected by ice).

Maximum discharge recorded during year ending September 30, 1920, 6,300 second-feet at 6.30 p. m. July 2 (gage height, 5.55 feet); minimum discharge, estimated 710 second-feet January 23 (stage-discharge relation affected by ice).

1914–1920: Maximum stage recorded, 6.73 feet April 22, 1916 (discharge, 8,480 second-feet); minimum discharge, estimated 700 second-feet February 2 and 6, 1918 (stage-discharge relation affected by ice).

ACCURACY.—Stage-discharge relation not permanent; affected by ice December 1, 1918, to March 25, 1919, and November 28, 1919, to March 26, 1920. Two fairly well defined rating curves used; one applicable October 1, 1918, to March 25, 1919, and March 27 to September 30, 1920, and the other applicable March 26, 1919, to March 26, 1920. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods of ice effect for which it was ascertained by means of gage heights, discharge measurements, observer's notes,and weather records. Open-water records good; winter records fair.

*Discharge measurements of St. Croix River at Swiss, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 9 | S. B. Soulé | 1.42 | 1,350 | Oct. 15 | S B. Soulé | 0.76 | 852 |
| | | | | Dec. 6[a] | J. W. Harris | 4.60 | 1,230 |
| 1919. | | | | | | | |
| Jan. 15[a] | R. S. Huffman | 1.90 | 886 | 1920. | | | |
| Feb. 12[a] | do | 2.07 | 828 | Jan. 9[a] | do | 2.35 | 829 |
| Mar. 8[a] | do | 2.16 | 822 | Feb. 10[a] | do | 3.07 | 911 |
| June 26 | S. B. Soulé | 1.75 | 1,530 | May 11 | S. B. Soulé | 1.57 | 1,520 |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 825 | 1,120 | 960 | 875 | 750 | 800 | 2,370 | 1,530 | 960 | 1,490 | 1,620 | 900 |
| 2 | 810 | 1,050 | 960 | 875 | 740 | 800 | 2,170 | 1,490 | 1,060 | 1,370 | 1,530 | 870 |
| 3 | 800 | 1,030 | 960 | 875 | 750 | 795 | 2,170 | 1,490 | 1,060 | 1,290 | 1,580 | 870 |
| 4 | 825 | 1,030 | 960 | 875 | 760 | 790 | 2,070 | 1,490 | 1,100 | 1,370 | 1,660 | 840 |
| 5 | 860 | 1,030 | 960 | 875 | 755 | 800 | 2,070 | 1,490 | 1,130 | 1,370 | 1,620 | 870 |
| 6 | 850 | 1,120 | 960 | 875 | 750 | 810 | 2,070 | 1,450 | 1,100 | 1,330 | 1,660 | 930 |
| 7 | 835 | 1,150 | 960 | 875 | 760 | 815 | 2,170 | 1,530 | 1,130 | 1,290 | 1,660 | 900 |
| 8 | 880 | 1,290 | 960 | 875 | 775 | 820 | 2,170 | 1,530 | 1,130 | 1,290 | 1,530 | 870 |
| 9 | 865 | 1,360 | 960 | 875 | 780 | 815 | 2,270 | 1,490 | 1,100 | 1,210 | 1,410 | 810 |
| 10 | 875 | 1,360 | 960 | 875 | 790 | 810 | 2,890 | 1,530 | 1,130 | 1,170 | 1,330 | 840 |
| 11 | 860 | 1,290 | 960 | 875 | 810 | 810 | 3,330 | 1,490 | 1,210 | 1,130 | 1,210 | 810 |
| 12 | 850 | 1,290 | 960 | 875 | 830 | 815 | 3,110 | 1,450 | 1,330 | 1,060 | 1,130 | 785 |
| 13 | 835 | 1,180 | 960 | 875 | 860 | 845 | 2,890 | 1,370 | 1,410 | 990 | 1,290 | 785 |
| 14 | 825 | 1,220 | 960 | 875 | 890 | 875 | 2,670 | 1,370 | 1,370 | 1,060 | 1,410 | 785 |
| 15 | 830 | 1,150 | 960 | 885 | 920 | 920 | 2,570 | 1,290 | 1,250 | 1,060 | 1,370 | 785 |
| 16 | 845 | 1,150 | 960 | 865 | 950 | 970 | 2,370 | 1,410 | 1,170 | 990 | 1,330 | 760 |
| 17 | 830 | 1,220 | 960 | 860 | 925 | 1,040 | 2,270 | 1,370 | 1,130 | 960 | 1,370 | 760 |
| 18 | 815 | 1,260 | 960 | 850 | 900 | 1,120 | 2,070 | 1,330 | 1,130 | 930 | 1,290 | 760 |
| 19 | 835 | 1,290 | 960 | 870 | 900 | 1,300 | 1,980 | 1,250 | 1,530 | 900 | 1,250 | 785 |
| 20 | 835 | 1,260 | 960 | 885 | 900 | 1,480 | 1,980 | 1,210 | 1,330 | 870 | 1,170 | 760 |
| 21 | 815 | 1,180 | 930 | 890 | 910 | 1,600 | 1,980 | 1,170 | 1,210 | 840 | 1,130 | 760 |
| 22 | 825 | 1,180 | 900 | 890 | 920 | 1,820 | 1,980 | 1,130 | 1,250 | 810 | 1,100 | 760 |
| 23 | 880 | 1,120 | 900 | 910 | 900 | 2,080 | 1,890 | 1,130 | 1,450 | 785 | 1,100 | 785 |
| 24 | 912 | 1,120 | 875 | 930 | 885 | 2,330 | 1,890 | 1,100 | 1,620 | 810 | 1,060 | 785 |
| 25 | 906 | 1,060 | 875 | 930 | 850 | 2,630 | 1,800 | 1,100 | 1,660 | 840 | 990 | 760 |
| 26 | 900 | 1,060 | 875 | 930 | 810 | 2,780 | 1,760 | 1,020 | 1,580 | 930 | 990 | 760 |
| 27 | 966 | 1,030 | 875 | 900 | 805 | 2,780 | 1,760 | 990 | 1,530 | 930 | 960 | 760 |
| 28 | 1,080 | 1,010 | 875 | 865 | 800 | 2,890 | 1,710 | 990 | 1,580 | 930 | 930 | 760 |
| 29 | 1,120 | 1,000 | 875 | 830 | ..... | 3,000 | 1,620 | 960 | 1,660 | 930 | 900 | 760 |
| 30 | 1,120 | 966 | 875 | 800 | ..... | 2,890 | 1,620 | 930 | 1,580 | 1,290 | 930 | 760 |
| 31 | 1,080 | ..... | 875 | 775 | ..... | 2,570 | ..... | 930 | ..... | 1,660 | 930 | ..... |

*Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 810 | 1,060 | 1,170 | 870 | 860 | 870 | 4,380 | 2,040 | 1,950 | 4,650 | 1,120 | 1,020 |
| 2 | 930 | 1,100 | 1,170 | 840 | 870 | 870 | 3,990 | 2,040 | 2,130 | 6,220 | 1,120 | 990 |
| 3 | 900 | 1,100 | 1,170 | 810 | 870 | 870 | 3,280 | 1,860 | 2,130 | 5,880 | 1,120 | 960 |
| 4 | 870 | 1,130 | 1,210 | 800 | 870 | 870 | 3,170 | 1,770 | 2,040 | 5,100 | 1,080 | 960 |
| 5 | 870 | 1,130 | 1,210 | 785 | 870 | 870 | 2,950 | 1,680 | 2,040 | 4,250 | 1,080 | 960 |
| 6 | 870 | 1,130 | 1,210 | 800 | 870 | 870 | 2,730 | 1,640 | 2,040 | 3,630 | 1,080 | 960 |
| 7 | 870 | 1,100 | 1,210 | 810 | 880 | 870 | 2,530 | 1,640 | 1,860 | 2,230 | 1,080 | 960 |
| 8 | 840 | 1,130 | 1,210 | 820 | 900 | 870 | 2,330 | 1,560 | 1,820 | 2,950 | 1,050 | 930 |
| 9 | 870 | 1,170 | 1,190 | 830 | 900 | 870 | 2,230 | 1,480 | 1,820 | 2,730 | 1,050 | 930 |
| 10 | 870 | 1,580 | 1,170 | 820 | 910 | 900 | 2,130 | 1,400 | 1,820 | 2,430 | 1,050 | 960 |
| 11 | 870 | 1,980 | 1,170 | 810 | 900 | 990 | 2,130 | 1,480 | 2,430 | 2,330 | 1,050 | 1,020 |
| 12 | 840 | 1,980 | 1,170 | 810 | 900 | 1,060 | 2,040 | 1,480 | 2,530 | 2,130 | 1,080 | 1,050 |
| 13 | 840 | 1,890 | 1,170 | 810 | 870 | 1,210 | 2,040 | 1,440 | 2,430 | 2,040 | 1,080 | 1,050 |
| 14 | 840 | 1,530 | 1,170 | 800 | 870 | 1,330 | 2,040 | 1,360 | 2,330 | 2,040 | 1,050 | 1,020 |
| 15 | 840 | 1,490 | 1,140 | 785 | 870 | 1,450 | 1,950 | 1,290 | 2,230 | 1,860 | 1,050 | 960 |
| 16 | 840 | 1,710 | 1,100 | 770 | 870 | 1,530 | 1,950 | 1,260 | 2,430 | 1,820 | 1,050 | 960 |
| 17 | 810 | 1,890 | 1,080 | 760 | 870 | 1,620 | 1,860 | 1,220 | 2,530 | 1,680 | 1,020 | 930 |
| 18 | 810 | 1,890 | 1,060 | 760 | 870 | 1,710 | 1,860 | 1,220 | 2,330 | 1,600 | 1,020 | 930 |
| 19 | 810 | 1,800 | 1,060 | 760 | 870 | 1,800 | 1,820 | 1,360 | 2,230 | 1,520 | 1,020 | 960 |
| 20 | 840 | 1,760 | 1,060 | 760 | 870 | 1,980 | 1,860 | 1,440 | 1,950 | 1,520 | 1,080 | 990 |
| 21 | 870 | 1,800 | 1,020 | 760 | 870 | 2,170 | 1,950 | 1,480 | 1,820 | 1,480 | 1,080 | 1,050 |
| 22 | 840 | 1,710 | 990 | 735 | 870 | 2,270 | 2,040 | 1,950 | 1,720 | 1,440 | 1,080 | 1,050 |
| 23 | 870 | 1,620 | 975 | 710 | 870 | 2,670 | 2,130 | 2,730 | 1,600 | 1,440 | 1,050 | 1,020 |
| 24 | 870 | 1,530 | 960 | 735 | 870 | 3,570 | 2,230 | 2,840 | 1,480 | 1,440 | 1,020 | 990 |
| 25 | 900 | 1,410 | 960 | 760 | 870 | 4,370 | 2,230 | 2,630 | 1,440 | 1,400 | 990 | 960 |
| 26 | 930 | 1,250 | 960 | 770 | 870 | 5,400 | 2,230 | 2,530 | 1,480 | 1,400 | 990 | 990 |
| 27 | 960 | 1,100 | 960 | 785 | 870 | 6,050 | 2,430 | 2,530 | 1,860 | 1,320 | 960 | 990 |
| 28 | 990 | 1,100 | 960 | 800 | 870 | 5,720 | 2,430 | 2,430 | 2,840 | 1,290 | 960 | 960 |
| 29 | 990 | 1,130 | 960 | 810 | 870 | 5,720 | 2,330 | 2,230 | 3,390 | 1,260 | 960 | 960 |
| 30 | 1,020 | 1,130 | 960 | 825 | ..... | 4,950 | 2,230 | 2,040 | 3,630 | 1,220 | 1,020 | 960 |
| 31 | 1,020 | ..... | 920 | 840 | ..... | 4,650 | ..... | 1,950 | ..... | 1,160 | 1,020 | ..... |

*Monthly discharge of St. Croix River at Swiss, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,550 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,120 | 800 | 884 | 0.570 | 0.66 |
| November | 1,360 | 966 | 1,150 | .742 | .83 |
| December | 960 | 875 | 933 | .602 | .69 |
| January | 930 | 775 | 875 | .565 | .65 |
| February | 950 | 740 | 835 | .539 | .56 |
| March | 3,000 | 790 | 1,470 | .948 | 1.09 |
| April | 3,330 | 1,620 | 2,190 | 1.41 | 1.57 |
| May | 1,530 | 930 | 1,290 | .832 | .96 |
| June | 1,660 | 960 | 1,300 | .839 | .94 |
| July | 1,660 | 785 | 1,090 | .703 | .81 |
| August | 1,660 | 900 | 1,270 | .819 | .94 |
| September | 930 | 760 | 804 | .519 | .58 |
| The year | 3,330 | 740 | 1,180 | .761 | 10.28 |
| 1919–20. | | | | | |
| October | 1,020 | 810 | 881 | .568 | .65 |
| November | 1,980 | 1,060 | 1,440 | .929 | 1.04 |
| December | 1,210 | 920 | 1,090 | .703 | .81 |
| January | 870 | 710 | 792 | .511 | .59 |
| February | 910 | 860 | 876 | .565 | .61 |
| March | 6,050 | 870 | 2,290 | 1.48 | 1.71 |
| April | 4,380 | 1,820 | 2,380 | 1.54 | 1.72 |
| May | 2,840 | 1,220 | 1,810 | 1.17 | 1.35 |
| June | 3,630 | 1,440 | 2,140 | 1.38 | 1.54 |
| July | 6,220 | 1,160 | 2,370 | 1.53 | 1.76 |
| August | 1,120 | 960 | 1,050 | .677 | .78 |
| September | 1,050 | 930 | 981 | .633 | .71 |
| The year | 6,220 | 710 | 1,510 | .974 | 13.27 |

*Days of deficiency in discharge of St. Croix River at Swiss, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 650 | | | | 0 | | | 0 | 0 |
| 700 | | 0 | 0 | 2 | 0 | 0 | 2 | .1 |
| 750 | | 8 | 16 | 26 | 4 | 3 | 57 | 2.6 |
| 800 | 0 | 21 | 47 | 71 | 39 | 14 | 192 | 8.8 |
| 900 | 71 | 55 | 109 | 149 | 135 | 86 | 605 | 27.6 |
| 1,000 | 117 | 73 | 136 | 220 | 192 | 137 | 875 | 39.9 |
| 1,200 | 237 | 120 | 209 | 280 | 245 | 204 | 1,295 | 59.1 |
| 1,400 | 252 | 190 | 284 | 319 | 288 | 222 | 1,555 | 70.9 |
| 1,600 | 289 | 242 | 313 | 334 | 316 | 248 | 1,742 | 79.4 |
| 1,800 | 293 | 261 | 320 | 340 | 331 | 262 | 1,807 | 82.4 |
| 2,000 | 306 | 283 | 339 | 342 | 338 | 299 | 1,907 | 87.0 |
| 2,200 | 332 | 297 | 358 | 344 | 349 | 311 | 1,991 | 90.8 |
| 2,400 | 342 | 308 | 363 | 347 | 353 | 325 | 2,038 | 92.9 |
| 2,600 | 345 | 318 | 364 | 352 | 355 | 337 | 2,071 | 94.4 |
| 2,800 | 347 | 331 | 365 | 365 | 359 | 343 | 2,110 | 96.2 |
| 3,000 | 352 | 336 | | | 363 | 346 | 2,127 | 97.0 |
| 3,500 | 357 | 345 | | | 365 | 349 | 2,146 | 97.9 |
| 4,000 | 363 | 349 | | | | 353 | 2,160 | 98.5 |
| 5,500 | 365 | 355 | | | | 361 | 2,176 | 99.3 |
| 6,000 | | 357 | | | | 364 | 2,181 | 99.5 |
| 7,000 | | 362 | | | | 366 | 2,188 | 99.8 |
| 8,000 | | 364 | | | | | 2,190 | 99.9 |
| 9,000 | | 366 | | | | | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 1,370 | 1,730 | 1,200 | 1,090 | 1,180 | 1,510 | | |
| Maximum (sec.-ft.) | 4,230 | 8,220 | 2,780 | 2,950 | 3,330 | 6,220 | | |
| Minimum (sec.-ft.) | [a] 815 | 720 | 710 | 700 | 740 | 710 | | |

[a] Mean discharge estimated 815 sec. ft., Jan. 21–31, 1915.

### ST. CROIX RIVER NEAR ST. CROIX FALLS, WIS.

LOCATION.—In sec. 18, T. 34 N., R. 18 W., at power plant of Minneapolis General Electric Co., on Wisconsin side of St. Croix River near St. Croix Falls, Polk County, 50 miles above confluence of St. Croix and Mississippi rivers near Hastings, Minn. Apple River, draining an area wholly in Wisconsin, enters from left 20 miles below station; Snake River, draining an area in Minnesota, enters from right 35 miles above station.

DRAINAGE AREA.—5,930 square miles.

RECORDS AVAILABLE.—January 1, 1910, to September 30, 1920. Data for 1903 published in Water-Supply Paper 98, pages 176–177, under "St. Croix River near Taylors Falls, Minn." Daily and monthly discharge, January 10, 1902, to June 30, 1905, and monthly estimates, July, 1905, to December, 1909, published in the "Report of water-resources investigations of Minnesota, 1909–1912," by the Minnesota State Drainage Commission.

DISCHARGE.—Determinations of discharge based on kilowatt output of dynamo and exciters, plus flow over dam and spillway, considered as a weir.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year ending September 30, 1919, 14,900 second-feet April 12; minimum discharge, 726 second-feet October 6.

Maximum discharge recorded during year ending September 30, 1920, 35,800 second-feet March 26; minimum discharge, 234 second-feet November 2.

1902–1920: Maximum discharge recorded, 35,800 second-feet March 26, 1920; minimum discharge, 75 second-feet July 17, 1910 (caused by regulation).

REGULATION.—Low-water flow controlled by operation of gates of power plant and by storage and release of water at Never's dam several miles upstream.

ACCURACY.—Records probably reliable but have not been checked, nor have discharge measurements been made, by engineers of the United States Geological Survey.

COOPERATION.—Records of daily discharge furnished by the Minneapolis General Electric Co.

*Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for the years ending Sept. 30, 1919 and 1920..*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 1,600 | 2,860 | 1,220 | 1,610 | 2,800 | 1,970 | 10,200 | 5,720 | 1,990 | 4,610 | 1,830 | 1,390 |
| 2 | 1,430 | 2,170 | 1,800 | 2,220 | 2,320 | 1,200 | 10,100 | 4,560 | 3,690 | 4,440 | 3,300 | 2,330 |
| 3 | 1,300 | 1,290 | 1,640 | 1,580 | 1,660 | 2,060 | 9,940 | 4,820 | 2,580 | 4,190 | 2,070 | 1,670 |
| 4 | 1,360 | 1,930 | 1,630 | 2,470 | 1,770 | 1,640 | 9,640 | 6,840 | 2,510 | 2,440 | 4,730 | 2,080 |
| 5 | 1,540 | 2,110 | 1,280 | 1,730 | 1,880 | 1,830 | 9,430 | 4,390 | 3,000 | 3,570 | 4,270 | 2,260 |
| 6 | 726 | 3,370 | 1,360 | 2,080 | 1,970 | 1,590 | 7,720 | 4,430 | 3,390 | 3,190 | 4,690 | 2,280 |
| 7 | 1,380 | 3,020 | 2,960 | 2,020 | 1,900 | 2,160 | 9,240 | 4,630 | 2,950 | 4,080 | 4,610 | 1,210 |
| 8 | 1,270 | 3,770 | 1,520 | 2,070 | 1,920 | 1,910 | 9,940 | 5,730 | 1,320 | 4,140 | 4,200 | 2,070 |
| 9 | 1,180 | 3,510 | 2,680 | 2,030 | 1,260 | 1,310 | 9,950 | 5,870 | 3,050 | 4,130 | 6,430 | 2,080 |
| 10 | 1,540 | 1,780 | 1,980 | 2,300 | 1,560 | 1,890 | 10,000 | 6,950 | 3,640 | 4,380 | 6,050 | 2,380 |
| 11 | 1,190 | 2,180 | 2,170 | 2,350 | 1,750 | 2,090 | 14,200 | 6,950 | 4,280 | 4,030 | 4,480 | 2,320 |
| 12 | 1,890 | 3,500 | 2,070 | 1,620 | 1,690 | 3,140 | 14,900 | 6,710 | 3,860 | 2,900 | 4,490 | 1,780 |
| 13 | 1,350 | 2,690 | 2,970 | 1,770 | 1,760 | 2,860 | 12,900 | 6,620 | 3,920 | 1,550 | 4,560 | 1,660 |
| 14 | 1,450 | 3,020 | 2,100 | 1,550 | 1,880 | 1,790 | 14,200 | 4,990 | 4,420 | 3,570 | 4,470 | 1,080 |
| 15 | 1,560 | 3,160 | 2,010 | 2,250 | 2,010 | 2,790 | 14,300 | 5,040 | 2,540 | 3,590 | 4,360 | 2,370 |
| 16 | 1,580 | 3,380 | 2,520 | 1,890 | 1,440 | 1,230 | 13,900 | 4,800 | 4,780 | 2,710 | 4,280 | 2,240 |
| 17 | 1,650 | 2,280 | 2,250 | 2,020 | 1,900 | 3,290 | 13,600 | 4,980 | 5,300 | 2,260 | 2,470 | 2,180 |
| 18 | 1,590 | 2,360 | 2,360 | 2,490 | 1,810 | 2,840 | 13,600 | 6,350 | 4,080 | 2,300 | 3,920 | 1,870 |
| 19 | 1,730 | 2,660 | 2,660 | 1,660 | 1,900 | 3,200 | 8,540 | 4,600 | 4,030 | 2,260 | 4,420 | 1,520 |
| 20 | 1,440 | 2,740 | 2,770 | 1,680 | 1,930 | 4,130 | 6,020 | 4,560 | 4,200 | 1,590 | 3,030 | 2,370 |
| 21 | 2,040 | 2,750 | 3,290 | 2,400 | 1,950 | 4,530 | 7,500 | 4,600 | 4,260 | 2,520 | 3,190 | 1,190 |
| 22 | 1,860 | 3,310 | 1,680 | 2,570 | 2,210 | 7,850 | 8,600 | 4,590 | 3,550 | 1,940 | 2,900 | 1,740 |
| 23 | 1,920 | 2,530 | 2,710 | 2,000 | 1,410 | 6,930 | 6,810 | 4,610 | 4,300 | 2,000 | 2,840 | 1,790 |
| 24 | 1,580 | 1,570 | 3,260 | 2,510 | 1,970 | 7,910 | 5,740 | 4,650 | 7,270 | 2,160 | 2,180 | 1,750 |
| 25 | 1,480 | 1,570 | 1,680 | 2,210 | 1,920 | 9,930 | 6,980 | 2,490 | 8,930 | 1,840 | 3,080 | 1,770 |
| 26 | 1,650 | 2,410 | 2,260 | 1,690 | 1,970 | 7,740 | 7,740 | 3,750 | 6,970 | 2,010 | 2,450 | 2,120 |
| 27 | 1,950 | 3,180 | 2,230 | 1,730 | 1,740 | 13,200 | 5,970 | 4,150 | 6,530 | 1,410 | 2,310 | 1,790 |
| 28 | 1,900 | 1,520 | 2,530 | 2,150 | 2,060 | 13,200 | 4,820 | 2,630 | 6,720 | 1,700 | 2,050 | 965 |
| 29 | 3,250 | 2,710 | 1,720 | 1,950 | ..... | 13,000 | 5,290 | 2,690 | 4,960 | 2,290 | 1,880 | 1,580 |
| 30 | 1,930 | 2,210 | 2,500 | 1,900 | ..... | 10,500 | 5,430 | 1,320 | 4,380 | 2,330 | 2,350 | 2,080 |
| 31 | 3,090 | ..... | 2,760 | 2,010 | ..... | 11,300 | ..... | 2,330 | ..... | 2,430 | 1,640 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 2,100 | 2,630 | 2,270 | 925 | 922 | 2,050 | 22,000 | 9,370 | 6,630 | 11,400 | 1,580 | 2,100 |
| 2 | 1,970 | 234 | 2,380 | 2,650 | 1,830 | 2,310 | 21,000 | 8,530 | 9,460 | 11,100 | 2,610 | 1,900 |
| 3 | 2,230 | 2,680 | 3,000 | 2,580 | 2,060 | 1,950 | 18,900 | 6,600 | 10,700 | 10,900 | 2,640 | 2,040 |
| 4 | 2,270 | 2,980 | 3,460 | 645 | 2,110 | 1,830 | 16,500 | 5,450 | 10,900 | 9,730 | 2,490 | 1,780 |
| 5 | 1,390 | 3,000 | 3,060 | 2,760 | 1,900 | 1,770 | 15,500 | 4,780 | 10,400 | 9,050 | 2,230 | 1,630 |
| 6 | 2,360 | 3,040 | 3,220 | 2,120 | 2,030 | 1,980 | 14,100 | 4,780 | 9,280 | 9,740 | 2,130 | 1,930 |
| 7 | 2,470 | 2,970 | 2,070 | 2,180 | 1,860 | 1,050 | 13,400 | 4,780 | 7,190 | 6,640 | 2,080 | 1,900 |
| 8 | 2,110 | 2,870 | 3,190 | 1,700 | 1,180 | 2,070 | 11,500 | 4,770 | 6,980 | 9,600 | 2,220 | 1,970 |
| 9 | 2,140 | 1,530 | 2,600 | 1,800 | 2,360 | 1,580 | 10,900 | 3,630 | 6,820 | 6,900 | 2,140 | 2,010 |
| 10 | 2,120 | 4,030 | 2,810 | 2,250 | 2,130 | 1,900 | 10,600 | 4,210 | 6,510 | 8,620 | 2,180 | 2,080 |
| 11 | 2,130 | 4,650 | 2,840 | 753 | 2,040 | 2,240 | 10,100 | 6,080 | 5,800 | 8,150 | 2,270 | 1,830 |
| 12 | 4,310 | 4,640 | 2,660 | 2,210 | 1,860 | 2,140 | 8,600 | 7,010 | 8,670 | 5,440 | 1,930 | 1,740 |
| 13 | 2,110 | 4,240 | 2,530 | 2,040 | 2,200 | 2,360 | 13,000 | 5,060 | 9,710 | 5,040 | 2,040 | 2,280 |
| 14 | 2,180 | 3,170 | 1,920 | 2,010 | 1,790 | 1,920 | 5,950 | 6,040 | 9,220 | 4,820 | 2,180 | 2,800 |
| 15 | 2,010 | 4,170 | 2,560 | 2,050 | 1,370 | 2,880 | 4,700 | 5,650 | 11,000 | 4,910 | 1,420 | 3,290 |
| 16 | 2,040 | 3,470 | 2,240 | 1,980 | 2,040 | 1,980 | 6,110 | 5,390 | 11,200 | 4,880 | 2,100 | 3,250 |
| 17 | 2,220 | 4,130 | 2,090 | 2,070 | 2,240 | 3,160 | 6,130 | 5,220 | 11,200 | 4,860 | 2,250 | 2,120 |
| 18 | 1,900 | 4,700 | 1,960 | 921 | 2,040 | 3,080 | 6,450 | 4,750 | 11,200 | 3,540 | 2,250 | 1,680 |
| 19 | 1,020 | 4,810 | 2,180 | 2,350 | 1,980 | 3,250 | 4,980 | 4,890 | 9,710 | 4,400 | 2,370 | 1,000 |
| 20 | 2,280 | 4,780 | 2,340 | 2,230 | 2,000 | 3,550 | 5,160 | 6,230 | 7,360 | 4,220 | 2,420 | 3,330 |
| 21 | 2,160 | 4,840 | 2,120 | 1,850 | 1,950 | 1,940 | 5,280 | 6,480 | 6,090 | 4,120 | 1,540 | 4,280 |
| 22 | 2,060 | 4,780 | 2,270 | 1,910 | 1,280 | 3,510 | 6,060 | 7,680 | 4,580 | 3,790 | 1,580 | 2,780 |
| 23 | 1,950 | 3,460 | 2,320 | 1,790 | 1,690 | 7,070 | 6,070 | 9,250 | 4,640 | 3,640 | 1,980 | 2,720 |
| 24 | 2,050 | 4,860 | 2,830 | 1,800 | 2,240 | 24,600 | 8,480 | 10,800 | 4,810 | 3,230 | 2,210 | 2,390 |
| 25 | 2,120 | 4,670 | 1,600 | 1,000 | 2,220 | 35,500 | 9,390 | 11,100 | 4,880 | 2,000 | 2,160 | 2,200 |
| 26 | 1,210 | 4,710 | 2,440 | 1,780 | 1,970 | 35,800 | 8,290 | 10,800 | 4,740 | 3,340 | 2,160 | 2,480 |
| 27 | 2,740 | 2,730 | 2,430 | 1,660 | 1,910 | 34,000 | 10,400 | 9,120 | 7,070 | 2,830 | 1,920 | 2,420 |
| 28 | 2,830 | 2,410 | 1,020 | 1,800 | 1,950 | 27,400 | 10,600 | 7,300 | 10,500 | 2,730 | 1,740 | 2,320 |
| 29 | 2,250 | 2,430 | 2,780 | 1,950 | 946 | 27,300 | 4,710 | 6,690 | 11,000 | 3,010 | 1,620 | 2,350 |
| 30 | 2,500 | 1,400 | 2,860 | 2,070 | ..... | 25,500 | 4,640 | 7,820 | 11,500 | 2,730 | 2,150 | 2,330 |
| 31 | 2,380 | ..... | 2,740 | 2,060 | ..... | 24,200 | ..... | 6,400 | ..... | 3,110 | 2,010 | ..... |

*Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 5,930 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 3,250 | 726 | 1,660 | 0.280 | 0.32 |
| November | 3,770 | 1,290 | 2,580 | .435 | .49 |
| December | 3,290 | 1,220 | 2,210 | .373 | .43 |
| January | 2,570 | 1,550 | 2,020 | .341 | .39 |
| February | 2,800 | 1,260 | 1,870 | .315 | .33 |
| March | 13,200 | 1,200 | 4,870 | .821 | .95 |
| April | 14,900 | 4,820 | 9,570 | 1.61 | 1.80 |
| May | 6,950 | 1,320 | 4,750 | .801 | .92 |
| June | 8,930 | 1,320 | 4,250 | .717 | .80 |
| July | 4,610 | 1,410 | 2,860 | .482 | .56 |
| August | 6,430 | 1,640 | 3,530 | .595 | .69 |
| September | 2,370 | 965 | 1,870 | .315 | .35 |
| The year | 14,900 | 726 | 3,510 | .592 | 8.03 |
| 1919–20. | | | | | |
| October | 4,310 | 1,020 | 2,180 | .368 | .42 |
| November | 4,860 | 234 | 3,500 | .590 | .66 |
| December | 3,460 | 1,020 | 2,480 | .418 | .48 |
| January | 2,760 | 645 | 1,870 | .315 | .36 |
| February | 2,360 | 922 | 1,860 | .314 | .34 |
| March | 35,800 | 1,050 | 9,420 | 1.59 | 1.83 |
| April | 22,000 | 4,640 | 9,980 | 1.68 | 1.87 |
| May | 11,100 | 3,630 | 6,670 | 1.12 | 1.29 |
| June | 11,500 | 4,580 | 8,320 | 1.40 | 1.56 |
| July | 11,400 | 2,000 | 5,760 | .971 | 1.12 |
| August | 2,640 | 1,420 | 2,080 | .351 | .40 |
| September | 4,200 | 1,000 | 2,300 | .388 | .43 |
| The year | 35,800 | 234 | 4,700 | .793 | 10.76 |

NOTE.—Computed by U. S. Geol. Survey from records of daily discharge furnished by Minneapolis General Electric Co.

*Days of deficiency in discharge of St. Croix River near St. Croix Falls, Wis., for the years ending Sept. 30, 1911–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | | | | | Oct. 1, 1910, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1910–11 | 1911–12 | 1912–13 | 1913–14 | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per-cent of time. |
| 300 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 0 | ..... | 1 | 1 | 0.03 |
| 500 | 0 | ..... | ..... | ..... | 0 | ..... | ..... | 1 | ..... | 1 | 2 | .05 |
| 700 | 13 | 0 | 0 | ..... | 1 | 0 | ..... | 6 | 0 | 2 | 22 | .6 |
| 900 | 25 | 8 | 1 | 0 | 5 | 2 | ..... | 13 | 1 | 3 | 58 | 1.6 |
| 1,100 | 41 | 22 | 5 | 3 | 17 | 5 | 0 | 21 | 3 | 12 | 129 | 3.5 |
| 1,300 | 67 | 46 | 43 | 5 | 32 | 11 | 6 | 32 | 15 | 15 | 272 | 7.4 |
| 1,500 | 105 | 81 | 73 | 25 | 52 | 19 | 18 | 61 | 30 | 19 | 483 | 13.2 |
| 1,700 | 178 | 116 | 96 | 60 | 77 | 29 | 61 | 112 | 66 | 30 | 825 | 22.6 |
| 1,900 | 217 | 149 | 113 | 85 | 101 | 53 | 100 | 152 | 102 | 47 | 1,119 | 30.6 |
| 2,100 | 232 | 189 | 132 | 102 | 124 | 79 | 125 | 191 | 141 | 100 | 1,415 | 38.7 |
| 2,300 | 267 | 225 | 139 | 117 | 155 | 99 | 149 | 218 | 169 | 151 | 1,689 | 46.2 |
| 2,500 | 277 | 248 | 152 | 126 | 180 | 116 | 175 | 230 | 191 | 174 | 1,869 | 51.2 |
| 2,700 | 288 | 260 | 181 | 139 | 204 | 137 | 205 | 244 | 207 | 185 | 2,050 | 56.1 |
| 2,900 | 301 | 265 | 199 | 147 | 226 | 145 | 221 | 258 | 222 | 203 | 2,187 | 59.9 |
| 3,100 | 308 | 267 | 209 | 152 | 245 | 175 | 239 | 275 | 231 | 211 | 2,312 | 63.3 |
| 3,300 | 313 | 271 | 224 | 168 | 256 | 197 | 250 | 293 | 244 | 220 | 2,441 | 66.8 |
| 3,500 | 323 | 274 | 248 | 194 | 265 | 212 | 260 | 304 | 252 | 225 | 2,557 | 70.0 |
| 4,000 | 331 | 277 | 291 | 252 | 280 | 235 | 311 | 317 | 261 | 231 | 2,786 | 76.3 |
| 5,500 | 357 | 322 | 320 | 294 | 291 | 262 | 328 | 343 | 312 | 278 | 3,107 | 85.1 |
| 8,500 | 365 | 347 | 360 | 338 | 334 | 291 | 344 | 358 | 339 | 311 | 3,387 | 92.7 |
| 13,000 | ..... | 360 | 365 | 359 | 360 | 317 | 362 | 365 | 356 | 350 | 3,559 | 97.4 |
| 21,000 | ..... | 363 | ..... | 365 | 365 | 351 | 365 | ..... | 365 | 356 | 3,625 | 99.2 |
| 30,000 | ..... | 365 | ..... | ..... | ..... | 359 | ..... | ..... | ..... | 363 | 3,642 | 99.7 |
| 40,000 | ..... | 366 | ..... | ..... | ..... | 366 | ..... | ..... | ..... | 366 | 3,653 | 100.0 |
| Mean discharge (sec.-ft.) | 2,110 | 3,190 | 2,680 | 3,970 | 3,580 | 6,040 | 3,250 | 2,590 | 3,510 | 4,700 | ..... | ..... |
| Maximum (sec.-ft.) | 7,500 | 33,500 | 8,980 | 15,300 | 15,100 | 35,100 | 17,700 | 10,100 | 14,900 | 35,800 | ..... | ..... |
| Minimum (sec.-ft.) | 557 | 710 | 760 | 1,030 | 686 | 740 | 1,120 | 603 | 726 | 234 | ..... | ..... |

### NAMAKAGON RIVER AT TREGO, WIS.

LOCATION.—In sec. 35, T. 40 N., R. 12 W., at Chicago, St. Paul, Minneapolis & Omaha Railway bridge at Trego, Washburn County, 20 miles above confluence of Namakagon and Totogatic rivers.

DRAINAGE AREA.—420 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 11, 1914, to September 30, 1920.

GAGE.—Enameled staff fastened to retaining wall, left bank of river, just above railroad bridge; read by Patrick Lawton.

DISCHARGE MEASUREMENTS.—Made from lower chords of railroad bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; free from vegetation; practically permanent. Banks medium high and not subject to overflow. Small island downstream with rapids on either side forms the control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 2.3 feet at 7.55 a. m. March 21 and 7.45 a. m. April 13 (discharge, 803 second-feet); minimum discharge, estimated 265 second-feet March 7–12.

Maximum stage recorded during year ending September 30, 1920, 3.25 feet June 30 (discharge, 1,530 second-feet); minimum discharge, 317 second-feet January 8, by current-meter measurement.

1914–1920: Maximum stage recorded, 3.25 feet June 30, 1920 (discharge, 1,530 second-feet); minimum discharge, estimated 235 second-feet December 19, 1916 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent; except as affected by ice December 24, 1918, to March 18, 1919, and November 28, 1919, to March 23, 1920. One rating curve used; well defined between 330 and 1,330 second-feet. Gage read to quarter-tenths once daily, except during ice-affected periods when it was read every other day. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, discharge measurements, observer's notes, and weather records, and except for days during open-water periods when gage was not read, for which it was interpolated. Open-water records excellent; winter records fair.

*Discharge measurements of Namakagon River at Trego, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 16[a] | R. S. Huffman | 2.25 | 334 | Jan. 8[a] | J. W. Harris | 2.57 | 317 |
| Feb. 13[a] | do | 2.15 | 353 | Feb. 11[a] | do | 2.75 | 408 |
| Mar. 10[a] | do | 1.75 | 266 | | | | |
| June 27 | S. B. Soulé | 1.87 | 515 | | | | |
| Dec. 8[a] | J. W. Harris | 2.72 | 372 | | | | |

[a] Complete ice cover at measuring section and at control.

*Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 320 | 369 | 417 | 340 | 320 | 280 | 532 | 597 | 417 | 369 | 393 | 369 |
| 2 | 332 | 369 | 393 | 340 | 320 | 280 | 564 | 630 | 417 | 369 | 369 | 369 |
| 3 | 332 | 369 | 369 | 340 | 320 | 275 | 532 | 597 | 417 | 393 | 444 | 369 |
| 4 | 332 | 369 | 381 | 340 | 325 | 275 | 532 | 597 | 417 | 472 | 417 | 369 |
| 5 | 350 | 369 | 393 | 340 | 325 | 270 | 532 | 532 | 417 | 444 | 417 | 417 |
| 6 | 332 | 393 | 418 | 340 | 325 | 270 | 532 | 502 | 417 | 417 | 417 | 393 |
| 7 | 332 | 417 | 444 | 340 | 325 | 265 | 532 | 532 | 417 | 444 | 444 | 369 |
| 8 | 369 | 472 | 397 | 340 | 330 | 265 | 664 | 532 | 393 | 417 | 444 | 369 |
| 9 | 350 | 472 | 350 | 340 | 330 | 265 | 630 | 502 | 369 | 417 | 417 | 369 |
| 10 | 369 | 444 | 397 | 335 | 330 | 265 | 698 | 472 | 369 | 417 | 417 | 369 |
| 11 | 350 | 417 | 444 | 335 | 340 | 265 | 733 | 332 | 393 | 417 | 417 | 369 |
| 12 | 332 | 417 | 444 | 335 | 345 | 265 | 768 | 350 | 369 | 393 | 417 | 350 |
| 13 | 332 | 417 | 444 | 335 | 355 | 270 | 803 | 417 | 369 | 393 | 444 | 350 |
| 14 | 332 | 393 | 430 | 335 | 355 | 270 | 803 | 472 | 369 | 369 | 417 | 332 |
| 15 | 332 | 393 | 417 | 335 | 355 | 270 | 768 | 472 | 393 | 369 | 472 | 332 |
| 16 | 332 | 393 | 417 | 335 | 350 | 290 | 733 | 502 | 369 | 369 | 472 | 369 |
| 17 | 332 | 417 | 417 | 335 | 350 | 330 | 664 | 472 | 369 | 369 | 472 | 369 |
| 18 | 320 | 417 | 417 | 335 | 345 | 415 | 664 | 444 | 369 | 350 | 472 | 369 |
| 19 | 332 | 417 | 417 | 335 | 340 | 564 | 597 | 417 | 369 | 350 | 417 | 332 |
| 20 | 332 | 393 | 430 | 335 | 340 | 684 | 664 | 417 | 417 | 332 | 444 | 332 |
| 21 | 332 | 369 | 444 | 330 | 330 | 803 | 698 | 417 | 369 | 350 | 444 | 350 |
| 22 | 332 | 320 | 397 | 330 | 320 | 668 | 664 | 393 | 393 | 369 | 444 | 350 |
| 23 | 332 | 320 | 350 | 330 | 310 | 532 | 768 | 444 | 393 | 369 | 417 | 369 |
| 24 | 332 | 393 | 350 | 330 | 310 | 615 | 664 | 417 | 417 | 393 | 417 | 369 |
| 25 | 369 | 332 | 350 | 330 | 310 | 698 | 597 | 417 | 444 | 369 | 417 | 332 |
| 26 | 350 | 393 | 350 | 320 | 300 | 733 | 664 | 417 | 472 | 369 | 417 | 350 |
| 27 | 369 | 472 | 345 | 320 | 300 | 768 | 597 | 417 | 472 | 369 | 417 | 332 |
| 28 | 417 | 393 | 345 | 320 | 295 | 733 | 664 | 393 | 472 | 369 | 417 | 350 |
| 29 | 417 | 369 | 345 | 320 | ..... | 698 | 698 | 369 | 444 | 369 | 393 | 369 |
| 30 | 417 | 350 | 340 | 320 | ..... | 648 | 664 | 393 | 417 | 369 | 393 | 350 |
| 31 | 393 | ..... | 340 | 320 | ..... | 597 | ..... | 417 | ..... | 369 | 369 | ..... |
| 1919 20. | | | | | | | | | | | | |
| 1 | 350 | 417 | 425 | 360 | 395 | 380 | 1,020 | 630 | 444 | 1,490 | 417 | 417 |
| 2 | 350 | 444 | 415 | 360 | 405 | 380 | 873 | 597 | 532 | 1,410 | 369 | 369 |
| 3 | 369 | 417 | 410 | 345 | 415 | 380 | 838 | 597 | 564 | 1,330 | 417 | 369 |
| 4 | 369 | 472 | 400 | 330 | 410 | 380 | 803 | 564 | 532 | 1,170 | 417 | 393 |
| 5 | 369 | 472 | 395 | 330 | 410 | 390 | 803 | 532 | 502 | 1,020 | 417 | 393 |
| 6 | 369 | 472 | 390 | 330 | 370 | 390 | 803 | 532 | 532 | 944 | 417 | 332 |
| 7 | 369 | 472 | 380 | 325 | 330 | 390 | 803 | 502 | 532 | 944 | 417 | 369 |
| 8 | 369 | 472 | 375 | 320 | 350 | 390 | 803 | 472 | 532 | 873 | 417 | 369 |
| 9 | 369 | 472 | 390 | 325 | 370 | 395 | 768 | 472 | 564 | 873 | 417 | 369 |
| 10 | 369 | 564 | 360 | 330 | 390 | 395 | 768 | 472 | 532 | 803 | 417 | 369 |
| 11 | 369 | 733 | 330 | 335 | 410 | 400 | 768 | 532 | 664 | 803 | 417 | 369 |
| 12 | 393 | 733 | 340 | 340 | 410 | 400 | 768 | 472 | 630 | 733 | 417 | 444 |
| 13 | 369 | 597 | 365 | 350 | 410 | 410 | 768 | 444 | 664 | 768 | 444 | 417 |
| 14 | 369 | 597 | 365 | 365 | 410 | 410 | 733 | 444 | 664 | 733 | 417 | 393 |
| 15 | 369 | 664 | 365 | 365 | 410 | 415 | 733 | 417 | 698 | 698 | 417 | 369 |
| 16 | 369 | 681 | 365 | 365 | 410 | 415 | 698 | 417 | 873 | 664 | 417 | 369 |
| 17 | 369 | 698 | 365 | 370 | 400 | 415 | 664 | 393 | 803 | 630 | 417 | 369 |
| 18 | 350 | 664 | 365 | 375 | 400 | 415 | 664 | 444 | 733 | 630 | 393 | 369 |
| 19 | 350 | 630 | 365 | 390 | 395 | 415 | 664 | 444 | 664 | 630 | 393 | 417 |
| 20 | 369 | 630 | 380 | 405 | 395 | 415 | 664 | 417 | 630 | 630 | 393 | 393 |
| 21 | 369 | 630 | 390 | 395 | 395 | 445 | 664 | 417 | 597 | 597 | 417 | 393 |
| 22 | 350 | 566 | 400 | 385 | 395 | 470 | 664 | 472 | 597 | 597 | 369 | 393 |
| 23 | 369 | 502 | 415 | 380 | 395 | 595 | 664 | 597 | 532 | 597 | 369 | 350 |
| 24 | 393 | 487 | 405 | 370 | 395 | 1,020 | 664 | 564 | 502 | 597 | 369 | 369 |
| 25 | 417 | 472 | 395 | 385 | 395 | 1,490 | 664 | 532 | 472 | 564 | 369 | 369 |
| 26 | 369 | 458 | 380 | 395 | 395 | 1,410 | 698 | 532 | 630 | 532 | 393 | 369 |
| 27 | 369 | 444 | 370 | 395 | 395 | 1,330 | 733 | 532 | 803 | 532 | 369 | 369 |
| 28 | 393 | 500 | 360 | 395 | 395 | 1,250 | 664 | 532 | 1,020 | 502 | 369 | 369 |
| 29 | 393 | 470 | 345 | 395 | 395 | 1,170 | 664 | 502 | 1,330 | 472 | 393 | 393 |
| 30 | 369 | 445 | 350 | 395 | ..... | 1,090 | 664 | 472 | 1,490 | 472 | 369 | 393 |
| 31 | 417 | ..... | 360 | 395 | ..... | 1,020 | ..... | 417 | ..... | 444 | 417 | ..... |

NOTE.—Discharge interpolated on account of lack of gage readings, Dec. 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 1918; Mar. 20, 22, 24, 26, 28, 30, and Nov. 16, 18, 20, 22, 24, 26, 1919.

*Monthly discharge of Namakagon River at Trego, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 420 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 417 | 320 | 349 | 0.831 | 0.96 |
| November | 472 | 320 | 394 | .938 | 1.05 |
| December | 444 | 340 | 393 | .936 | 1.08 |
| January | 340 | 320 | 333 | .793 | .91 |
| February | 355 | 295 | 329 | .783 | .82 |
| March | 803 | 265 | 446 | 1.06 | 1.22 |
| April | 803 | 532 | 654 | 1.56 | 1.74 |
| May | 630 | 332 | 461 | 1.10 | 1.27 |
| June | 472 | 369 | 404 | .962 | 1.07 |
| July | 472 | 332 | 385 | .917 | 1.06 |
| August | 472 | 369 | 425 | 1.01 | 1.16 |
| September | 417 | 332 | 360 | .857 | .96 |
| The year | 803 | 265 | 411 | .979 | 13.30 |
| 1919–20. | | | | | |
| October | 417 | 350 | 372 | .886 | 1.02 |
| November | 733 | 417 | 543 | 1.29 | 1.44 |
| December | 425 | 330 | 377 | .898 | 1.04 |
| January | 405 | 320 | 365 | .869 | 1.00 |
| February | 415 | 330 | 395 | .940 | 1.01 |
| March | 1,490 | 380 | 622 | 1.48 | 1.71 |
| April | 1,020 | 664 | 738 | 1.76 | 1.96 |
| May | 630 | 393 | 496 | 1.18 | 1.36 |
| June | 1,490 | 444 | 675 | 1.61 | 1.80 |
| July | 1,490 | 444 | 784 | 1.82 | 2.10 |
| August | 444 | 369 | 402 | .957 | 1.10 |
| September | 444 | 332 | 381 | .907 | 1.01 |
| The year | 1,490 | 320 | 510 | 1.21 | 16.55 |

*Days of deficiency in discharge of Namakagon River at Trego, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 230 | ..... | ..... | 0 | ..... | ..... | ..... | 0 | 0.0 |
| 245 | ..... | ..... | 3 | 0 | ..... | ..... | 3 | .1 |
| 260 | ..... | ..... | 12 | 5 | 0 | ..... | 17 | .8 |
| 275 | ..... | ..... | 25 | 9 | 13 | ..... | 47 | 2.1 |
| 290 | 0 | ..... | 42 | 33 | 21 | ..... | 96 | 4.4 |
| 305 | 41 | 0 | 76 | 50 | 22 | ..... | 189 | 8.6 |
| 320 | 41 | 10 | 87 | 87 | 54 | 0 | 279 | 12.7 |
| 335 | 72 | 30 | 120 | 124 | 97 | 10 | 453 | 20.7 |
| 350 | 72 | 40 | 123 | 156 | 132 | 15 | 538 | 24.5 |
| 365 | 86 | 55 | 138 | 161 | 132 | 29 | 601 | 27.4 |
| 380 | 108 | 76 | 162 | 248 | 187 | 90 | 871 | 39.7 |
| 395 | 139 | 90 | 183 | 268 | 215 | 127 | 1,022 | 46.6 |
| 410 | 150 | 93 | 185 | 275 | 218 | 159 | 1,080 | 49.3 |
| 425 | 205 | 130 | 199 | 305 | 276 | 208 | 1,323 | 60.4 |
| 440 | 206 | 131 | 202 | 308 | 278 | 209 | 1,334 | 60.8 |
| 455 | 247 | 154 | 215 | 317 | 297 | 221 | 1,451 | 66.2 |
| 475 | 257 | 192 | 265 | 332 | 312 | 240 | 1,598 | 72.9 |
| 500 | 257 | 192 | 267 | 332 | 312 | 242 | 1,602 | 73.1 |
| 550 | 294 | 243 | 313 | 342 | 323 | 264 | 1,779 | 81.2 |
| 650 | 329 | 280 | 334 | 345 | 338 | 294 | 1,920 | 87.6 |
| 800 | 350 | 325 | 362 | 349 | 362 | 333 | 2,081 | 94.9 |
| 1,000 | 360 | 344 | 365 | 364 | 365 | 349 | 2,147 | 98.0 |
| 1,350 | 365 | 366 | ..... | 365 | ..... | 361 | 2,187 | 99.8 |
| 1,500 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 457 | 542 | 428 | 389 | 411 | 510 | ..... | ..... |
| Maximum (sec.-ft.) | 1,020 | 1,330 | 803 | 1,020 | 803 | 1,490 | ..... | ..... |
| Minimum (sec.-ft.) | [a]290 | 308 | 235 | 255 | 265 | 320 | ..... | ..... |

[a] Estimated.

### APPLE RIVER NEAR SOMERSET, WIS.

LOCATION.—In sec. 21, T. 31 N., R. 19 W., at power plant of St. Croix Power Co., 2 miles above mouth of river and 3½ miles below Somerset, St. Croix County.

DRAINAGE AREA.—550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—January, 1901, to September 30, 1920.

GAGE.—Vertical staff gage; readings not used in determination of flow.

DISCHARGE.—The discharge of the turbines in second-feet corresponding to the number of kilowatts is determined for each hour during day from a record of the number of wheels in operation and the load; the sum of these figures divided by 24 gives the average discharge through the turbines. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving daily flow through power house. Water is seldom wasted over spillway of dam, but when it is so wasted the quantity is computed from weir formulas and added to the flow through plant. There is a constant leakage through the gate and flashboards amounting to 3 second-feet. This quantity has not been taken into consideration in computing the records.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year ending September 30, 1919, 1,120 second-feet April 12; minimum discharge, 90 second-feet January 26 and July 6.

Maximum discharge recorded during year ending September 30, 1920, 1,370 second-feet March 26; minimum discharge, 110 second-feet August 19.

1904–1920: Maximum discharge recorded, 2,280 second-feet in June, 1905; minimum discharge, 38 second-feet May 10, 1910. Owing to regulation the minimum discharge has no bearing on the natural minimum flow. No records of maximum and minimum stages are available for the period 1901 to 1903.

REGULATION.—There are a number of power plants above the station, but their pondage is small, and though the daily flow may be controlled to some extent, the mean monthly flow probably corresponds closely to the natural flow.

ACCURACY.—From 1901 to 1909 the discharge through the plant was determined from tables computed from data collected at tests on one of the turbines made at flume of Holyoke Water Power Co., Holyoke, Mass. In the summer of 1909 engineers of St. Croix Power Co. made tests on the water flowing through all the wheels as actually installed, by means of a sharp-crested weir 710 inches long located about 60 feet below power house. These tests gave results about 3 per cent larger than the Holyoke tests, and tables based on them have been used in determining the discharge through the plant from 1909 to date. In May, 1914, a series of current-meter measurements were made by the Wisconsin Railroad Commission and United States Geological Survey, and a rating curve for the tailrace was developed. Twelve tests were then run with different wheels and loads. It was found that the discharge as determined by the current meter and the discharge as computed by the company agreed very closely, the percentage difference for the twelve tests ranging from —6.4 per cent to +1.8 per cent, with an average of —2.0 per cent; the discharge as determined by the company being 2 per cent less than that determined by current meter. During 1919 three current-meter measurements were made to check the accuracy, under present conditions, of the data obtained in June, 1914. These measurements showed that power-plant records were about 5 per cent less than the measured discharge, due probably to increased leakage through the wheels. The records published below are the power-plant records increased by 5 per cent.

COOPERATION.—Records furnished by St. Paul Gas Light Co., of St. Paul, Minn., D. W. Flowers, engineer.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Apple River near Somerset, Wis., during the year ending Sept. 30, 1919.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| June 24 [a] | [b] −0.7 | 29 | June 24 [c] | [b] 1.93 | 427 | June 24 [d] | [b] 2.48 | 610 |

[a] Leakage through 4 idle wheels, and exciter, and direct from penstock into tailrace.
[b] Tailrace gage at power plant.
[c] Two units and one exciter in operation.
[d] Three units and one exciter in operation.

*Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 168 | 227 | 156 | 181 | 308 | 315 | 505 | 307 | 191 | 184 | 282 | 255 |
| 2 | 165 | 261 | 232 | 184 | 152 | 139 | 366 | 338 | 270 | 183 | 282 | 207 |
| 3 | 178 | 192 | 214 | 204 | 295 | 253 | 418 | 422 | 203 | 264 | 177 | 224 |
| 4 | 199 | 236 | 234 | 368 | 164 | 249 | 539 | 288 | 274 | 169 | 258 | 235 |
| 5 | 203 | 242 | 242 | 105 | 227 | 264 | 505 | 382 | 270 | 332 | 210 | 244 |
| 6 | 192 | 302 | 222 | 268 | 254 | 269 | 360 | 386 | 240 | 90 | 297 | 304 |
| 7 | 229 | 442 | 298 | 258 | 234 | 228 | 541 | 334 | 341 | 244 | 255 | 243 |
| 8 | 183 | 560 | 156 | 253 | 313 | 287 | 668 | 302 | 147 | 290 | 308 | 200 |
| 9 | 180 | 304 | 290 | 242 | 164 | 212 | 749 | 278 | 252 | 167 | 292 | 248 |
| 10 | 174 | 452 | 234 | 262 | 239 | 242 | 863 | 331 | 292 | 213 | 218 | 238 |
| 11 | 202 | 378 | 250 | 292 | 235 | 266 | 962 | 366 | 287 | 222 | 254 | 231 |
| 12 | 238 | 241 | 202 | 190 | 254 | 379 | 1,120 | 346 | 254 | 271 | 202 | 249 |
| 13 | 173 | 316 | 258 | 246 | 294 | 257 | 1,030 | 364 | 240 | 168 | 269 | 291 |
| 14 | 179 | 258 | 347 | 227 | 255 | 272 | 917 | 348 | 324 | 333 | 276 | 182 |
| 15 | 208 | 304 | 142 | 226 | 300 | 363 | 885 | 344 | 210 | 205 | 378 | 296 |
| 16 | 192 | 414 | 227 | 250 | 169 | 447 | 801 | 319 | 275 | 173 | 482 | 210 |
| 17 | 173 | 242 | 259 | 250 | 248 | 743 | 764 | 372 | 220 | 200 | 238 | 234 |
| 18 | 178 | 290 | 278 | 326 | 231 | 382 | 629 | 250 | 251 | 203 | 326 | 228 |
| 19 | 236 | 302 | 264 | 127 | 238 | 441 | 474 | 316 | 238 | 242 | 280 | 236 |
| 20 | 146 | 315 | 276 | 222 | 236 | 774 | 584 | 310 | 247 | 129 | 282 | 286 |
| 21 | 171 | 326 | 389 | 271 | 232 | 959 | 538 | 291 | 289 | 198 | 286 | 185 |
| 22 | 206 | 251 | 209 | 258 | 341 | 881 | 546 | 288 | 190 | 160 | 278 | 260 |
| 23 | 210 | 264 | 270 | 247 | 143 | 736 | 497 | 298 | 304 | 164 | 335 | 224 |
| 24 | 189 | 157 | 369 | 283 | 240 | 667 | 479 | 342 | 275 | 172 | 244 | 207 |
| 25 | 203 | 271 | 173 | 395 | 177 | 579 | 485 | 200 | 264 | 180 | 232 | 205 |
| 26 | 282 | 254 | 258 | 90 | 185 | 535 | 437 | 298 | 244 | 218 | 253 | 229 |
| 27 | 315 | 336 | 382 | 225 | 225 | 591 | 407 | 244 | 238 | 121 | 226 | 296 |
| 28 | 250 | 195 | 410 | 215 | 196 | 689 | 385 | 177 | 230 | 188 | 246 | 151 |
| 29 | 210 | 222 | 172 | 211 | ..... | 650 | 376 | 191 | 202 | 216 | 272 | 216 |
| 30 | 222 | 248 | 264 | 264 | ..... | 635 | 356 | 189 | 242 | 238 | 315 | 218 |
| 31 | 240 | ..... | 223 | 214 | ..... | 457 | ..... | 332 | ..... | 300 | 185 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 204 | 346 | 209 | 171 | 234 | 256 | 1,160 | 524 | 401 | 1,030 | 167 | 200 |
| 2 | 230 | 164 | 248 | 240 | 226 | 206 | 1,170 | 334 | 359 | 886 | 174 | 230 |
| 3 | 211 | 275 | 294 | 248 | 233 | 262 | 1,010 | 348 | 355 | 815 | 211 | 154 |
| 4 | 297 | 213 | 293 | 232 | 242 | 209 | 1,010 | 457 | 354 | 620 | 242 | 268 |
| 5 | 158 | 250 | 286 | 232 | 232 | 185 | 921 | 359 | 396 | 521 | 363 | 250 |
| 6 | 219 | 280 | 351 | 268 | 232 | 249 | 896 | 343 | 268 | 604 | 314 | 141 |
| 7 | 223 | 281 | 225 | 262 | 299 | 165 | 800 | 365 | 340 | 512 | 256 | 298 |
| 8 | 196 | 400 | 252 | 264 | 177 | 249 | 740 | 408 | 299 | 548 | 246 | 195 |
| 9 | 203 | 189 | 257 | 247 | 252 | 242 | 751 | 253 | 343 | 458 | 286 | 170 |
| 10 | 230 | 320 | 239 | 271 | 226 | 269 | 716 | 332 | 354 | 522 | 268 | 290 |
| 11 | 269 | 311 | 257 | 226 | 219 | 318 | 513 | 508 | 320 | 581 | 245 | 357 |
| 12 | 181 | 395 | 256 | 213 | 219 | 289 | 637 | 647 | 407 | 386 | 231 | 227 |
| 13 | 234 | 291 | 279 | 245 | 240 | 417 | 509 | 617 | 251 | 398 | 288 | 242 |
| 14 | 229 | 348 | 180 | 251 | 270 | 277 | 489 | 536 | 317 | 311 | 278 | 353 |
| 15 | 217 | 351 | 234 | 251 | 160 | 448 | 520 | 507 | 439 | 360 | 185 | 236 |
| 16 | 218 | 368 | 230 | 244 | 214 | 306 | 480 | 502 | 566 | 364 | 231 | 218 |
| 17 | 242 | 384 | 281 | 275 | 244 | 434 | 544 | 401 | 650 | 489 | 214 | 273 |
| 18 | 293 | 396 | 277 | 188 | 252 | 432 | 391 | 382 | 721 | 248 | 291 | 337 |
| 19 | 146 | 346 | 289 | 203 | 254 | 419 | 469 | 479 | 700 | 317 | 110 | 178 |
| 20 | 236 | 364 | 315 | 261 | 246 | 499 | 427 | 478 | 630 | 340 | 200 | 293 |
| 21 | 223 | 334 | 203 | 183 | 300 | 572 | 452 | 466 | 392 | 306 | 239 | 208 |
| 22 | 224 | 465 | 259 | 257 | 189 | 750 | 401 | 525 | 432 | 339 | 131 | 354 |
| 23 | 231 | 216 | 235 | 239 | 237 | 900 | 462 | 450 | 475 | 308 | 141 | 262 |
| 24 | 231 | 310 | 310 | 236 | 210 | 1,190 | 476 | 534 | 400 | 383 | 187 | 335 |
| 25 | 335 | 290 | 175 | 185 | 227 | 1,330 | 430 | 504 | 346 | 242 | 177 | 315 |
| 26 | 172 | 318 | 236 | 231 | 203 | 1,370 | 420 | 445 | 422 | 326 | 173 | 212 |
| 27 | 275 | 193 | 309 | 231 | 222 | 1,290 | 504 | 517 | 412 | 266 | 188 | 287 |
| 28 | 222 | 278 | 188 | 233 | 264 | 1,190 | 538 | 423 | 790 | 291 | 232 | 273 |
| 29 | 251 | 277 | 248 | 254 | 188 | 1,220 | 398 | 464 | 972 | 276 | 111 | 268 |
| 30 | 260 | 130 | 270 | 270 | ..... | 1,300 | 458 | 357 | 1,220 | 227 | 237 | 262 |
| 31 | 280 | ..... | 252 | 280 | ..... | 1,190 | ..... | 266 | ..... | 321 | 294 | ..... |

NOTE.—See note under "Discharge" in station description for method by which these records are obtained.

*Monthly discharge of Apple River near Somerset, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 550 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 315 | 146 | 203 | 0.369 | 0.43 |
| November | 560 | 157 | 293 | .533 | .59 |
| December | 410 | 142 | 255 | .464 | .53 |
| January | 395 | 90 | 237 | .431 | .50 |
| February | 341 | 143 | 234 | .425 | .44 |
| March | 959 | 139 | 457 | .831 | .96 |
| April | 1,120 | 356 | 606 | 1.10 | 1.23 |
| May | 422 | 177 | 308 | .560 | .65 |
| June | 341 | 147 | 250 | .455 | .51 |
| July | 333 | 90 | 208 | .378 | .44 |
| August | 482 | 177 | 272 | .495 | .57 |
| September | 304 | 151 | 234 | .425 | .47 |
| The year | 1,120 | 90 | 296 | .538 | 7.32 |
| 1919–20. | | | | | |
| October | 335 | 146 | 230 | .418 | .48 |
| November | 465 | 130 | 303 | .551 | .61 |
| December | 351 | 175 | 255 | .464 | .53 |
| January | 280 | 171 | 238 | .433 | .50 |
| February | 300 | 160 | 231 | .420 | .45 |
| March | 1,370 | 165 | 595 | 1.08 | 1.24 |
| April | 1,170 | 391 | 623 | 1.13 | 1.26 |
| May | 647 | 253 | 443 | .805 | .93 |
| June | 1,220 | 251 | 478 | .869 | .97 |
| July | 1,030 | 242 | 438 | .796 | .92 |
| August | 363 | 110 | 223 | .405 | .47 |
| September | 357 | 141 | 256 | .465 | .52 |
| The year | 1,370 | 110 | 360 | .655 | 8.88 |

*Days of deficiency in discharge of Apple River near Somerset, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 45 | ..... | 0 | ..... | ..... | ..... | ..... | 0 | 0.0 |
| 60 | ..... | 1 | 0 | 0 | ..... | ..... | 1 | .0 |
| 75 | ..... | 1 | 2 | 1 | 0 | ..... | 4 | .2 |
| 90 | 0 | 1 | 3 | 2 | 2 | ..... | 8 | .4 |
| 105 | 1 | 2 | 3 | 7 | 3 | 0 | 16 | .7 |
| 120 | 1 | 4 | 4 | 11 | 3 | 2 | 25 | 1.1 |
| 135 | 1 | 5 | 9 | 25 | 6 | 4 | 50 | 2.3 |
| 150 | 4 | 8 | 17 | 34 | 11 | 8 | 82 | 3.7 |
| 165 | 11 | 12 | 27 | 62 | 21 | 13 | 146 | 6.7 |
| 180 | 24 | 17 | 37 | 78 | 42 | 24 | 222 | 10.1 |
| 195 | 47 | 29 | 54 | 114 | 62 | 38 | 344 | 15.7 |
| 210 | 68 | 47 | 82 | 155 | 89 | 52 | 493 | 22.5 |
| 225 | 87 | 68 | 109 | 180 | 111 | 72 | 627 | 28.6 |
| 240 | 121 | 92 | 136 | 217 | 148 | 111 | 825 | 37.6 |
| 255 | 156 | 123 | 172 | 239 | 191 | 142 | 1,023 | 46.7 |
| 270 | 185 | 144 | 208 | 262 | 216 | 169 | 1,184 | 54.0 |
| 300 | 222 | 190 | 264 | 296 | 260 | 207 | 1,439 | 65.6 |
| 500 | 332 | 282 | 333 | 345 | 334 | 309 | 1,935 | 88.3 |
| 800 | 364 | 334 | 356 | 359 | 356 | 346 | 2,115 | 96.5 |
| 1,150 | 365 | 350 | 365 | 364 | 365 | 355 | 2,164 | 98.7 |
| 1,550 | ..... | 358 | ..... | 365 | ..... | 366 | 2,184 | 99.6 |
| 2,000 | ..... | 366 | ..... | ..... | ..... | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 310 | 415 | 296 | 262 | 296 | 360 | ..... | ..... |
| Maximum (sec.-ft.) | 824 | 1,800 | 966 | 1,160 | 1,120 | 1,370 | ..... | ..... |
| Minimum (sec.-ft.) | 104 | 58 | 62 | 63 | 90 | 110 | ..... | ..... |

NOTE.—Daily discharge, 1902 to 1914, not available.

### KINNIKINNIC RIVER NEAR RIVER FALLS, WIS.

LOCATION.—In sec. 18, T. 27, N., R. 19 W., at Clifton Hollow bridge, a quarter of a mile downstream from dam of Clifton Falls Power Co., 2 miles above mouth of river and 7 miles downstream from River Falls, Pierce County.

DRAINAGE AREA.—170 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—October 23, 1916, to September 30, 1920.

GAGE.—Gurley water-stage recorder, with a wooden well and shelter fastened to downstream side of right-hand cushing bridge pier.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rather heavy gravel and sand. Control is head of small rapids 150 feet below gage; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 7.0 feet at 4 p. m. March 12 (discharge, about 3,560 second-feet); minimum stage, between 1.7 and 1.8 feet (discharge, about 15 second-feet); occurred several times following complete shutdown of power plant. The maximum stage is about normal, but the minimum stage is affected by regulation at power house.

Maximum stage during year ending September 30, 1920, not known, on account of nonoperation of water-stage recorder; minimum stage recorded, 1.62 feet at 5 a. m. August 30 (discharge, 11 second-feet).

1917–1920: Maximum stage recorded, 7.0 feet March 12, 1919 (discharge, about 3,560 second-feet); minimum stage, 1.62 feet at 5 a. m. August 30, 1920 (discharge, 11 second-feet).

ICE.—Stage-discharge relation affected to some extent by ice.

REGULATION.—Daily flow is regulated almost completely by Clifton Falls Power Co.'s dam just above station. There are three dams in River Falls, operations at which may also have some effect on the daily flow, but the storage at these dams is relatively small, and the monthly flow is considered to be nearly the normal flow.

ACCURACY.—Stage-discharge relation not permanent; only slightly affected by ice. Owing to shifting control, discharge measurements made during 1919 and 1920 do not define a smooth curve, and therefore a curve was drawn which averages the measurements; used October 1, 1918, to September 30, 1920; poorly defined throughout. Continuous gage-height record obtained by recording gage except during winter and certain other brief periods noted in footnote to tables of daily discharge. Daily discharge ascertained by use of discharge integrator except for periods indicated in footnote to tables of daily discharge. Records poor.

*Discharge measurements of Kinnikinnic River near River Falls, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 4 | S. B. Soulé | 2.08 | 44 | Oct. 13 | S. B. Soulé | 2.50 | 132 |
| 4 | do | 3.02 | 268 | 13 | do | 3.02 | 298 |
| 1919. | | | | 1920. | | | |
| Feb. 22 | R. S. Huffman | 1.90 | 28 | Feb. 23 | J. W. Harris | 1.90 | 39.2 |
| 22 | do | 3.25 | 347 | May 10 | S. B. Soulé | 2.20 | 77 |
| Apr. 17 | S. B. Soulé | 2.50 | 143 | June 11 | W. G. Hoyt | 2.12 | 64 |
| June 22 | do | 2.43 | 130 | Sept. 29 | S. B. Soulé | 2.20 | 77 |

*Daily discharge, in second-feet, of Kinnikinnic River near River Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1. | | 68 | 103 | 88 | | | 105 | 109 | 87 | | 93 | 90 |
| 2. | | 58 | 75 | | | | 89 | 99 | 102 | | 80 | 85 |
| 3. | | 78 | 111 | | | | 84 | 64 | 84 | 70 | 87 | 50 |
| 4. | | 132 | 108 | | | | 80 | 92 | 96 | | 95 | 87 |
| 5. | | 67 | 100 | | | 90 | 60 | 76 | 87 | 104 | 122 | 113 |
| 6. | 70 | 115 | 93 | | | | 140 | 118 | 108 | 92 | 112 | 80 |
| 7. | | 117 | 112 | | | | 295 | 60 | 63 | 59 | 66 | 124 |
| 8. | | 167 | 94 | | | | 137 | 126 | 69 | 136 | 50 | 119 |
| 9. | | | 133 | | | 96 | 280 | 116 | 100 | 93 | 43 | 61 |
| 10. | | | 106 | | | 249 | 264 | 87 | 92 | 84 | 68 | 70 |
| 11. | | | 112 | | | 372 | 210 | 80 | 78 | 116 | 71 | 94 |
| 12. | | | 108 | | 65 | 1,520 | 160 | 82 | | 71 | 94 | 45 |
| 13. | 81 | 110 | 108 | | | | 104 | 94 | 75 | 84 | 77 | 78 |
| 14. | 48 | | | | | 2,500 | 132 | 80 | | 120 | 75 | 56 |
| 15. | 92 | | | | | | 93 | 106 | 72 | 97 | 87 | 93 |
| 16. | 72 | | | 70 | | 1,820 | 92 | 84 | 123 | 98 | 74 | 74 |
| 17. | 74 | | 90 | | | 573 | 103 | 73 | 112 | 158 | 67 | 99 |
| 18. | 74 | 94 | | | | 222 | 111 | 85 | 102 | | 114 | 128 |
| 19. | 61 | 81 | | | | 158 | 122 | 94 | 84 | | 103 | 68 |
| 20. | 75 | 76 | | | | 182 | 111 | 78 | 89 | | 77 | 60 |
| 21. | 77 | 85 | 121 | | | 109 | 100 | 97 | 109 | | 81 | 69 |
| 22. | 91 | 93 | 107 | | | 122 | 87 | 88 | 72 | 60 | 81 | |
| 23. | 86 | 122 | 121 | | 104 | 95 | 54 | 96 | 208 | | 83 | |
| 24. | 65 | 94 | 76 | | 107 | 105 | 80 | 104 | | | 85 | |
| 25. | 70 | 90 | 84 | | 80 | 166 | 87 | 74 | | | 75 | 65 |
| 26. | 99 | 140 | 85 | | 70 | 124 | 107 | 79 | 70 | | 73 | |
| 27. | 101 | 107 | 85 | | 95 | 90 | 72 | 96 | | 45 | | |
| 28. | 117 | 98 | 103 | | 132 | 86 | 94 | 74 | 73 | 99 | 60 | 135 |
| 29. | 106 | 106 | 88 | | ..... | 76 | 102 | 91 | 75 | 26 | | 103 |
| 30. | 95 | 108 | 103 | | ..... | 67 | 93 | 65 | 75 | 80 | | 74 |
| 31. | 102 | ..... | 108 | | ..... | 92 | ..... | 81 | ..... | 106 | 52 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1. | 77 | ..... | ..... | ..... | ..... | ..... | 116 | 85 | 86 | 133 | 55 | 22 |
| 2. | 80 | ..... | ..... | ..... | ..... | ..... | 115 | 84 | 83 | 178 | 32 | 21 |
| 3. | 84 | ..... | ..... | ..... | ..... | ..... | 94 | 80 | 88 | 52 | 28 | 21 |
| 4. | 80 | ..... | ..... | ..... | ..... | ..... | 116 | 82 | 89 | 45 | 23 | 21 |
| 5. | 101 | ..... | ..... | ..... | ..... | ..... | 111 | 88 | 78 | 44 | 14 | 20 |
| 6. | ..... | ..... | ..... | ..... | ..... | ..... | 94 | 87 | 93 | 69 | 15 | 20 |
| 7. | ..... | ..... | ..... | ..... | ..... | ..... | 100 | 91 | 96 | 44 | 18 | 18 |
| 8. | ..... | ..... | ..... | ..... | ..... | ..... | 96 | 88 | 105 | 44 | 19 | 24 |
| 9. | ..... | ..... | ..... | ..... | ..... | ..... | 97 | 90 | 96 | 37 | 23 | 30 |
| 10. | ..... | ..... | ..... | ..... | ..... | ..... | 86 | 125 | 92 | 32 | 22 | 30 |
| 11. | ..... | ..... | ..... | ..... | ..... | ..... | 102 | 114 | 95 | 36 | 22 | 28 |
| 12. | ..... | ..... | ..... | ..... | ..... | ..... | 95 | 93 | 96 | 44 | 23 | 27 |
| 13. | ..... | ..... | ..... | ..... | ..... | ..... | 96 | 91 | 93 | 43 | 30 | 25 |
| 14. | ..... | ..... | ..... | ..... | ..... | 137 | 96 | 91 | 490 | 33 | 29 | 24 |
| 15. | ..... | ..... | ..... | ..... | ..... | 2,870 | 92 | 91 | 486 | 21 | 23 | 32 |
| 16. | ..... | ..... | ..... | ..... | ..... | ..... | 78 | 98 | 182 | 19 | 30 | 28 |
| 17. | ..... | ..... | ..... | ..... | ..... | ..... | 88 | 97 | 111 | 22 | 21 | 28 |
| 18. | ..... | ..... | ..... | ..... | ..... | ..... | 99 | 113 | 98 | 31 | 23 | 32 |
| 19. | ..... | ..... | ..... | ..... | ..... | ..... | 98 | 101 | 103 | 30 | 28 | 35 |
| 20. | ..... | ..... | ..... | ..... | ..... | ..... | 87 | 93 | 97 | 28 | 18 | 31 |
| 21. | ..... | ..... | ..... | ..... | ..... | ..... | 92 | 172 | 108 | 26 | 51 | 38 |
| 22. | ..... | ..... | ..... | ..... | ..... | 1,470 | 114 | 162 | 93 | 33 | | 39 |
| 23. | ..... | ..... | ..... | ..... | ..... | 2,200 | 96 | 123 | 91 | 26 | | 53 |
| 24. | ..... | ..... | ..... | ..... | ..... | 574 | 86 | 97 | 90 | 23 | | 62 |
| 25. | ..... | ..... | ..... | ..... | ..... | 304 | 76 | 92 | 300 | 46 | 35 | 55 |
| 26. | ..... | ..... | ..... | ..... | ..... | 181 | 90 | 86 | 400 | 69 | | 74 |
| 27. | ..... | ..... | ..... | ..... | ..... | ..... | 116 | 82 | 425 | 30 | | 68 |
| 28. | ..... | ..... | ..... | ..... | ..... | 150 | 96 | 88 | 375 | 28 | | 174 |
| 29. | ..... | ..... | ..... | ..... | ..... | 149 | 88 | 100 | 187 | 30 | 17 | 82 |
| 30. | ..... | ..... | ..... | ..... | ..... | 122 | 92 | 82 | 183 | 18 | 13 | 95 |
| 31. | ..... | ..... | ..... | ..... | ..... | 123 | ..... | 97 | ..... | 35 | 28 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 2 to Feb. 22 and Mar. 1–8, 1919; mean discharge estimated. Recording gage not in operation Oct. 6, 1919, to Mar. 13, 1920, and Mar. 16–21, 27, 1920; discharge not determined. Recording gage not in operation Oct. 1–12, Nov. 9–17, Dec. 14–20, 1918; Mar. 13–15, June 12–14, 24–27, July 1–4, 18–26, Aug. 27–30, Sept. 22–27, 1919, and Aug. 22–28, 1920; mean discharge estimated by comparison with flow in adjacent river basins. Recording gage not in perfect operation Mar. 29, Apr. 11, 12, May 23, June 30, Aug. 1, 23, 1919; Apr. 17, 24, June 12, Aug. 7, and Sept. 18, 1920; discharge interpolated. Recording gage not in perfect operation, Aug. 8, Sept. 19, 20, 1919; June 24–26, and Sept. 2–5, 10, 11, 1920; discharge estimated by study of precipitation records. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kinnikinnic River near River Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 170 square miles.]

| Month. | Discharge in second-feet. | | | | Run off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | | | 78.3 | 0.461 | 0.53 |
| November | | | 103 | .606 | .68 |
| December | | | 99.2 | .584 | .67 |
| January | | | 70.6 | .415 | .48 |
| February | | | 72.1 | .424 | .44 |
| March | | | 469 | 2.76 | 3.18 |
| April | 295 | 54 | 122 | .718 | .80 |
| May | 126 | 60 | 88.6 | .521 | .60 |
| June | | | 88.8 | .522 | .58 |
| July | | | 80.3 | .472 | .54 |
| August | | | 78.2 | .460 | .53 |
| September | | | 81.2 | .478 | .53 |
| The year | | | 120 | .706 | 9.56 |
| 1920. | | | | | |
| April | 116 | 76 | 96.7 | .569 | .63 |
| May | 125 | 82 | 99.0 | .582 | .67 |
| June | 490 | 78 | 167 | .982 | 1.10 |
| July | 178 | 18 | 43.5 | .256 | .30 |
| August | 55 | 13 | 27.4 | .161 | .19 |
| September | 174 | 18 | 41.9 | .246 | .27 |

### CHIPPEWA RIVER AT BISHOPS BRIDGE, NEAR WINTER, WIS.

LOCATION.—In sec. 23, T. 39 N., R. 6 W., at highway bridge 3 miles downstream from East Fork of Chippewa River, which comes in from left, and 4 miles by road northwest of Winter, Sawyer County.

DRAINAGE AREA.—775 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 23, 1912, to September 30, 1920.

GAGE.—Chain gage fastened to bridge used since May 23, 1916; read by John Edberg. Gages previously used as follows: February 23, 1912, to January 27, 1914, a wooden staff gage fastened to a wooden pier on right bank just above bridge; datum 3.44 feet above that of chain gage; January 27, 1914, to May 28, 1916, a vertical cast iron staff gage fastened to the same pier; at same datum as chain gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; free from vegetation; permanent. One channel at all stages. Control is head of rapids about 1,000 feet below gage; practically permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 7.31 feet at 4 p. m. April 15 (discharge, 3,130 second-feet); minimum discharge, estimated 260 second-feet, February 23–28 and March 3–7 (stage-discharge relation affected by ice).

Maximum discharge recorded during year ending September 30, 1920, 3,680 second-feet at 9 a. m. March 31; minimum discharge, estimated 240 second-feet January 5 (stage-discharge relation affected by ice).

1912–1920: Maximum stage recorded, 9.56 feet April 22, 1916 (discharge, 6,940 second-feet); minimum discharge, estimated 175 second-feet February 17, 1917 (stage-discharge relation affected by ice).

REGULATION.—Flow regulated to some extent by operation of storage reservoir on West Fork of Chippewa River in sec. 14, T. 41 N., R. 6 W., about 16 miles above station. This reservoir has a capacity of 550 million cubic feet, and is used in connection with reservoirs on the Upper Flambeau River, for the purpose of regulating the flow of Chippewa River.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice November 23–24, 1918, December 26, 1918, to March 23, 1919, and November 28, 1919, to March 25, 1920. Rating curve well defined between 270 and 6,820 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records fair.

*Discharge measurements of Chippewa River at Bishops Bridge, near Winter, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 21[a] | R. S. Huffman | 6.28 | 358 | Jan. 16[a] | J.W. Harris | 5.97 | 401 |
| Feb. 19[a] | do | 5.49 | 264 | Feb. 17[a] | do | 6.15 | 367 |
| Mar. 13[a] | do | 5.56 | 266 | May 18 | Warren Oakey | 5.04 | 667 |
| June 28 | S. B. Soulé | 6.37 | 1,830 | | | | |
| Dec. 17[a] | J. W. Harris | 6.16 | 530 | | | | |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Chippewa River at Bishops Bridge, near Winter, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 340 | 750 | 610 | 675 | 320 | 265 | 1,400 | 1,300 | 480 | 1,460 | 2,310 | 580 |
| 2 | 360 | 790 | 640 | 660 | 315 | 265 | 1,300 | 1,250 | 480 | 1,200 | 1,980 | 530 |
| 3 | 322 | 675 | 870 | 640 | 310 | 260 | 1,150 | 1,200 | 480 | 960 | 1,800 | 480 |
| 4 | 360 | 610 | 750 | 620 | 305 | 260 | 1,100 | 1,100 | 480 | 1,250 | 1,570 | 430 |
| 5 | 340 | 530 | 750 | 600 | 305 | 260 | 1,050 | 1,050 | 455 | 1,680 | 1,400 | 480 |
| 6 | 322 | 580 | 610 | 580 | 300 | 260 | 1,150 | 1,050 | 455 | 1,800 | 1,300 | 530 |
| 7 | 340 | 870 | 750 | 560 | 300 | 260 | 1,200 | 1,150 | 430 | 1,800 | 1,150 | 640 |
| 8 | 322 | 870 | 640 | 540 | 295 | 265 | 1,680 | 1,150 | 480 | 1,920 | 1,050 | 580 |
| 9 | 340 | 915 | 675 | 530 | 295 | 265 | 1,980 | 1,050 | 505 | 1,980 | 915 | 505 |
| 10 | 322 | 870 | 640 | 520 | 290 | 265 | 2,180 | 960 | 555 | 1,860 | 870 | 455 |
| 11 | 322 | 870 | 480 | 510 | 285 | 265 | 2,570 | 915 | 640 | 1,800 | 790 | 430 |
| 12 | 340 | 915 | 675 | 490 | 280 | 265 | 2,700 | 870 | 675 | 1,620 | 710 | 405 |
| 13 | 322 | 830 | 480 | 480 | 280 | 265 | 2,840 | 830 | 610 | 1,350 | 750 | 380 |
| 14 | 340 | 790 | 455 | 460 | 275 | 270 | 3,120 | 790 | 580 | 1,250 | 870 | 380 |
| 15 | 322 | 710 | 505 | 450 | 270 | 275 | 3,120 | 790 | 710 | 1,200 | 1,000 | 380 |
| 16 | 322 | 710 | 610 | 430 | 270 | 305 | 2,980 | 790 | 915 | 1,050 | 1,050 | 380 |
| 17 | 360 | 710 | 455 | 410 | 270 | 340 | 2,840 | 750 | 960 | 960 | 1,100 | 360 |
| 18 | 340 | 640 | 430 | 390 | 265 | 360 | 2,570 | 710 | 960 | 870 | 1,100 | 360 |
| 19 | 360 | 675 | 405 | 380 | 265 | 405 | 2,180 | 750 | 1,200 | 790 | 1,050 | 360 |
| 20 | 340 | 640 | 430 | 370 | 265 | 480 | 2,050 | 750 | 1,150 | 710 | 1,000 | 360 |
| 21 | 340 | 710 | 430 | 360 | 265 | 640 | 1,920 | 710 | 1,050 | 675 | 960 | 405 |
| 22 | 360 | 675 | 480 | 360 | 265 | 870 | 1,800 | 710 | 915 | 640 | 960 | 405 |
| 23 | 340 | 675 | 610 | 350 | 260 | 1,150 | 1,740 | 710 | 830 | 640 | 960 | 405 |
| 24 | 360 | 675 | 675 | 340 | 260 | 1,460 | 1,620 | 750 | 1,350 | 640 | 915 | 405 |
| 25 | 340 | 710 | 870 | 340 | 260 | 1,570 | 1,570 | 710 | 1,800 | 750 | 870 | 405 |
| 26 | 340 | 750 | 830 | 340 | 260 | 1,800 | 1,520 | 640 | 2,180 | 870 | 790 | 380 |
| 27 | 380 | 710 | 810 | 330 | 260 | 1,980 | 1,460 | 555 | 1,980 | 960 | 675 | 380 |
| 28 | 430 | 610 | 790 | 330 | 260 | 1,570 | 1,520 | 530 | 1,860 | 1,150 | 580 | 380 |
| 29 | 505 | 640 | 770 | 320 | ..... | 1,520 | 1,400 | 505 | 1,860 | 1,250 | 580 | 380 |
| 30 | 610 | 580 | 740 | 320 | ..... | 1,620 | 1,300 | 480 | 1,740 | 1,620 | 610 | 380 |
| 31 | 750 | ..... | 710 | 320 | ..... | 1,570 | ..... | 480 | ..... | 2,180 | 610 | ..... |

*Daily discharge, in second-feet, of Chippewa River at Bishops Bridge, near Winter, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | | | | |
| 1 | 405 | 1,250 | 580 | 285 | 420 | 340 | 3,540 | 1,570 | 1,050 | 2,840 | 455 | 380 |
| 2 | 430 | 1,050 | 580 | 280 | 405 | 340 | 3,540 | 1,460 | 1,300 | 2,840 | 430 | 360 |
| 3 | 430 | 1,050 | 555 | 270 | 405 | 340 | 2,840 | 1,350 | 915 | 2,700 | 405 | 360 |
| 4 | 430 | 1,050 | 555 | 255 | 405 | 360 | 2,840 | 1,250 | 790 | 2,700 | 405 | 340 |
| 5 | 505 | 1,050 | 555 | 240 | 420 | 360 | 2,700 | 1,150 | 750 | 2,570 | 380 | 340 |
| 6 | 555 | 1,000 | 555 | 250 | 430 | 380 | 2,570 | 1,050 | 710 | 2,440 | 360 | 340 |
| 7 | 580 | 960 | 555 | 255 | 430 | 380 | 2,440 | 1,000 | 710 | 2,180 | 360 | 322 |
| 8 | 555 | 915 | 555 | 255 | 430 | 380 | 2,310 | 960 | 675 | 1,800 | 360 | 322 |
| 9 | 530 | 960 | 555 | 255 | 430 | 405 | 1,860 | 915 | 710 | 1,570 | 360 | 322 |
| 10 | 530 | 1,400 | 555 | 255 | 430 | 405 | 1,570 | 870 | 710 | 1,350 | 360 | 304 |
| 11 | 530 | 1,920 | 530 | 255 | 430 | 405 | 1,400 | 915 | 830 | 1,250 | 340 | 455 |
| 12 | 505 | 2,050 | 530 | 270 | 430 | 430 | 1,350 | 915 | 830 | 1,050 | 360 | 505 |
| 13 | 480 | 2,050 | 530 | 285 | 420 | 430 | 1,460 | 710 | 870 | 1,680 | 360 | 530 |
| 14 | 480 | 2,050 | 530 | 330 | 405 | 455 | 1,520 | 675 | 915 | 1,860 | 360 | 555 |
| 15 | 480 | 1,980 | 530 | 380 | 405 | 480 | 1,400 | 675 | 1,150 | 1,620 | 360 | 555 |
| 16 | 455 | 1,980 | 530 | 400 | 405 | 480 | 1,350 | 675 | 1,680 | 1,400 | 360 | 555 |
| 17 | 453 | 1,980 | 530 | 380 | 365 | 505 | 1,350 | 675 | 750 | 1,250 | 340 | 530 |
| 18 | 430 | 1,860 | 505 | 390 | 360 | 530 | 1,350 | 610 | 1,570 | 1,200 | 340 | 505 |
| 19 | 430 | 1,620 | 490 | 405 | 360 | 555 | 1,300 | 610 | 1,350 | 1,100 | 322 | 480 |
| 20 | 430 | 1,460 | 480 | 420 | 350 | 580 | 1,350 | 580 | 1,200 | 1,050 | 380 | 455 |
| 21 | 430 | 1,300 | 440 | 430 | 340 | 750 | 1,400 | 640 | 1,100 | 915 | 675 | 430 |
| 22 | 430 | 1,350 | 405 | 440 | 340 | 960 | 1,400 | 710 | 1,000 | 830 | 790 | 405 |
| 23 | 455 | 1,300 | 370 | 455 | 340 | 1,150 | 1,680 | 1,250 | 870 | 750 | 710 | 405 |
| 24 | 455 | 1,250 | 340 | 440 | 340 | 1,350 | 1,800 | 1,250 | 790 | 675 | 640 | 405 |
| 25 | 580 | 960 | 340 | 430 | 340 | 1,570 | 1,860 | 1,250 | 640 | 640 | 580 | 405 |
| 26 | 640 | 750 | 340 | 440 | 340 | 2,980 | 1,860 | 1,200 | 580 | 610 | 530 | 380 |
| 27 | 675 | 675 | 330 | 455 | 340 | 2,980 | 1,800 | 1,150 | 610 | 580 | 481 | 380 |
| 28 | 675 | 640 | 320 | 440 | 340 | 3,120 | 1,740 | 1,050 | 870 | 580 | 430 | 360 |
| 29 | 710 | 640 | 310 | 430 | 340 | 3,400 | 1,740 | 960 | 1,800 | 580 | 430 | 360 |
| 30 | 750 | 610 | 305 | 430 | ..... | 3,540 | 1,620 | 870 | 2,700 | 555 | 430 | 340 |
| 31 | 1,200 | ..... | 295 | 430 | ..... | 3,680 | ..... | 790 | ..... | 530 | 405 | ..... |

*Monthly discharge of Chippewa River at Bishops Bridge, near Winter, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 775 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 750 | 322 | 371 | 0.479 | 0.55 |
| November | 915 | 530 | 723 | .933 | 1.04 |
| December | 870 | 405 | 631 | .814 | .94 |
| January | 675 | 320 | 452 | .583 | .67 |
| February | 320 | 260 | 280 | .361 | .38 |
| March | 1,980 | 260 | 697 | .899 | 1.04 |
| April | 3,120 | 1,050 | 1,900 | 2.45 | 2.73 |
| May | 1,300 | 480 | 838 | 1.08 | 1.24 |
| June | 2,180 | 430 | 959 | 1.24 | 1.38 |
| July | 2,180 | 640 | 1,250 | 1.61 | 1.86 |
| August | 2,310 | 580 | 1,040 | 1.34 | 1.54 |
| September | 640 | 360 | 431 | .556 | .62 |
| The year | 3,120 | 260 | 800 | 1.03 | 13.99 |
| 1919-20. | | | | | |
| October | 1,200 | 405 | 536 | .692 | .80 |
| November | 2,050 | 610 | 1,300 | 1.68 | 1.87 |
| December | 580 | 295 | 470 | .606 | .70 |
| January | 455 | 240 | 353 | .456 | .53 |
| February | 430 | 340 | 386 | .498 | .54 |
| March | 3,680 | 340 | 1,100 | 1.42 | 1.64 |
| April | 3,540 | 1,300 | 1,900 | 2.45 | 2.73 |
| May | 1,570 | 580 | 959 | 1.24 | 1.43 |
| June | 2,700 | 580 | 1,010 | 1.31 | 1.46 |
| July | 2,840 | 530 | 1,410 | 1.82 | 2.10 |
| August | 790 | 322 | 435 | .561 | .65 |
| September | 555 | 304 | 413 | .533 | .59 |
| The year | 3,680 | 240 | 855 | 1.10 | 15.04 |

*Days of deficiency in discharge of Chippewa River at Bishops Bridge, near Winter, Wis., for the years ending Sept. 30, 1914–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | | Oct. 1, 1913, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|---|
| | 1913–14 | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 150 | ..... | ..... | ..... | 0 | 0 | ..... | ..... | 0 | 0.0 |
| 200 | ..... | ..... | ..... | 7 | 32 | ..... | ..... | 39 | 1.5 |
| 235 | 0 | ..... | 0 | 51 | 62 | 0 | 0 | 113 | 4.3 |
| 270 | 28 | 0 | 14 | 77 | 78 | 28 | 8 | 233 | 9.1 |
| 305 | 38 | 17 | 27 | 109 | 104 | 41 | 15 | 351 | 13.7 |
| 340 | 49 | 55 | 49 | 116 | 144 | 73 | 24 | 510 | 19.9 |
| 375 | 70 | 89 | 89 | 139 | 164 | 88 | 68 | 707 | 27.6 |
| 410 | 90 | 126 | 112 | 165 | 206 | 109 | 98 | 906 | 35.5 |
| 445 | 92 | 152 | 123 | 177 | 221 | 117 | 133 | 1,015 | 39.7 |
| 480 | 94 | 182 | 143 | 181 | 251 | 138 | 144 | 1,133 | 44.3 |
| 515 | 106 | 185 | 157 | 192 | 267 | 145 | 159 | 1,211 | 47.4 |
| 550 | 123 | 206 | 164 | 201 | 278 | 152 | 174 | 1,298 | 50.8 |
| 585 | 126 | 222 | 177 | 212 | 289 | 163 | 200 | 1,389 | 54.3 |
| 620 | 134 | 224 | 186 | 217 | 281 | 175 | 205 | 1,432 | 56.1 |
| 655 | 140 | 234 | 194 | 225 | 295 | 189 | 211 | 1,488 | 58.2 |
| 690 | 145 | 240 | 209 | 234 | 298 | 202 | 222 | 1,550 | 60.7 |
| 725 | 152 | 247 | 215 | 247 | 300 | 216 | 230 | 1,607 | 62.8 |
| 760 | 157 | 257 | 219 | 257 | 301 | 230 | 236 | 1,657 | 64.8 |
| 800 | 167 | 264 | 226 | 265 | 306 | 240 | 240 | 1,708 | 66.8 |
| 1,300 | 312 | 289 | 297 | 322 | 340 | 310 | 291 | 2,161 | 84.7 |
| 2,000 | 351 | 335 | 340 | 348 | 352 | 351 | 341 | 2,418 | 94.7 |
| 3,000 | 359 | 358 | 346 | 365 | 365 | 363 | 360 | 2,516 | 98.3 |
| 4,500 | 365 | 365 | 359 | ..... | ..... | 365 | 366 | 2,550 | 99.7 |
| ,000 | ..... | ..... | 361 | ..... | ..... | ..... | ..... | 2,552 | 99.8 |
| 7,500 | ..... | ..... | 366 | ..... | ..... | ..... | ..... | 2,557 | 100.0 |
| Mean discharge (sec.-ft.) | 881 | 806 | 961 | 675 | 546 | 800 | 855 | ..... | ..... |
| Maximum (sec.-ft.) | 3,280 | 3,540 | 6,820 | 2,980 | 2,980 | 3,120 | 3,680 | ..... | ..... |
| Minimum (sec.-ft.) | ..... | 304 | 238 | 175 | 180 | 260 | 240 | ..... | ..... |

### CHIPPEWA RIVER NEAR BRUCE, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 7 W., at Minneapolis, St. Paul & Sault Ste. Marie Railway bridge 1 mile east of Bruce, Rusk County. Thornapple River enters from left immediately above station and Flambeau River from left about 21 miles below.

DRAINAGE AREA.—1,600 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 31, 1913, to September 30, 1920.

GAGE.—Chain gage, attached to downstream side of Minneapolis, St. Paul & Sault Ste. Marie Railway bridge; read by H. C. Gardner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and small gravel; free from vegetation; first and second channels from the west fairly permanent; third channel nearest east bank has a tendency to fill during low stages with sand worked in by Thornapple River. Flow, except during extreme high stages, is confined within the banks.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year ending September 30, 1919, 9.1 feet at 6 p. m. April 11 (discharge, 8,320 second-feet); minimum discharge, 460 second-feet February 11 (determined by current-meter measurement).

Maximum open-water stage recorded during year ending September 30, 1920, 12.5 feet at 6 p. m. March 27 (discharge, 13,800 second-feet); minimum discharge, estimated 480 second-feet January 5 (stage-discharge relation affected by ice).

1914–1920: Maximum open-water stage recorded, 12.5 feet March 27, 1920 (discharge, 13,800 second-feet); minimum stage, 1.15 feet, morning and afternoon reading, August 21, 1918 (discharge, about 260 second-feet); caused by regulation.

REGULATION.—Flow regulated to some extent by reservoir on West Fork of Chippewa River, in sec. 14, T. 41 N., R. 6 W. Reservoir has a capacity of 550 million cubic feet, and is used in connection with reservoirs on Upper Flambeau River, for purpose of regulating the flow of Chippewa River. No diurnal fluctuation is observed.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control at low stages and by ice during periods December 1, 1918, to March 24, 1919, and November 29, 1919, to March 26, 1920. Gage read to quarter-tenths twice daily. Two rating curves, both fairly well defined, used during 1919 and 1920, applicable respectively, October 1, 1918, to September 30, 1919, and October 1, 1919, to September 30, 1920. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, discharge measurements, observer's notes, and weather records, and except for periods March 25 to September 30, 1919, and July 1 to September 30, 1920, for which it was ascertained by the indirect method for shifting control. Open-water records fair; winter records subject to error.

*Discharge measurements of Chippewa River near Bruce, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 8 | S. B. Soulé | 4.33 | 2,830 | Oct. 16 | S. B. Soulé | 2.10 | 959 |
| 1919. | | | | Dec. 16[a] | J. W. Harris | 4.60 | 1,050 |
| Jan. 13[a] | R. S. Huffman | 3.40 | 635 | 1920. | | | |
| Feb. 11[a] | do | 2.89 | 460 | Jan. 17[a] | do | 3.55 | 656 |
| Mar. 6[a] | do | 2.92 | 488 | Feb. 20[a] | do | 3.64 | 675 |
| Apr. 16 | S. B. Soulé | 6.32 | 4,790 | Apr. 22 | S. B. Soulé | 3.97 | 2,700 |
| July 1 | do | 3.21 | 1,860 | June 14 | W. G. Hoyt | 2.62 | 1,410 |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 550 | 1,430 | 900 | 725 | 515 | 480 | 2,900 | 2,030 | 795 | 1,850 | 3,980 | 970 |
| 2 | 550 | 1,350 | 900 | 720 | 510 | 480 | 2,600 | 1,940 | 795 | 1,670 | 3,650 | 935 |
| 3 | 515 | 1,270 | 900 | 710 | 500 | 480 | 2,400 | 1,940 | 830 | 1,510 | 3,210 | 865 |
| 4 | 515 | 1,270 | 900 | 700 | 490 | 490 | 2,300 | 2,400 | 830 | 3,540 | 2,900 | 795 |
| 5 | 480 | 1,110 | 900 | 690 | 480 | 490 | 2,300 | 2,120 | 830 | 5,200 | 2,800 | 830 |
| 6 | 515 | 1,430 | 900 | 690 | 480 | 490 | 2,600 | 2,300 | 830 | 5,560 | 3,000 | 970 |
| 7 | 550 | 1,940 | 900 | 680 | 470 | 500 | 3,320 | 2,300 | 795 | 4,640 | 4,200 | 1,040 |
| 8 | 585 | 2,700 | 900 | 670 | 470 | 520 | 4,640 | 2,300 | 795 | 3,980 | 3,760 | 1,080 |
| 9 | 585 | 2,900 | 900 | 670 | 470 | 530 | 5,800 | 2,120 | 795 | 3,430 | 2,600 | 935 |
| 10 | 585 | 2,500 | 900 | 660 | 460 | 550 | 6,290 | 1,850 | 830 | 3,100 | 2,210 | 830 |
| 11 | 585 | 2,120 | 900 | 660 | 460 | 620 | 8,120 | 1,670 | 935 | 2,600 | 1,760 | 795 |
| 12 | 620 | 1,850 | 900 | 650 | 460 | 660 | 7,850 | 1,590 | 1,040 | 2,300 | 1,430 | 760 |
| 13 | 585 | 1,670 | 900 | 640 | 460 | 690 | 6,940 | 1,430 | 1,040 | 2,120 | 1,430 | 725 |
| 14 | 585 | 1,510 | 900 | 640 | 460 | 720 | 6,040 | 1,350 | 935 | 2,400 | 1,760 | 690 |
| 15 | 585 | 1,430 | 900 | 630 | 470 | 760 | 5,200 | 1,270 | 970 | 2,900 | 1,940 | 690 |
| 16 | 550 | 1,350 | 900 | 620 | 470 | 1,110 | 4,750 | 1,510 | 1,040 | 2,400 | 1,940 | 690 |
| 17 | 550 | 1,430 | 900 | 610 | 470 | 1,590 | 4,420 | 1,670 | 1,270 | 1,940 | 1,850 | 655 |
| 18 | 585 | 1,590 | 900 | 600 | 480 | 1,850 | 3,980 | 1,430 | 1,510 | 1,510 | 2,030 | 655 |
| 19 | 585 | 1,510 | 900 | 590 | 480 | 2,400 | 3,430 | 1,350 | 1,430 | 1,350 | 1,940 | 655 |
| 20 | 585 | 1,430 | 900 | 580 | 480 | 2,800 | 3,430 | 1,270 | 1,590 | 1,270 | 1,760 | 690 |
| 21 | 550 | 1,430 | 890 | 570 | 480 | 3,320 | 3,540 | 1,190 | 1,590 | 1,350 | 2,030 | 795 |
| 22 | 585 | 1,270 | 870 | 570 | 480 | 3,870 | 3,100 | 1,190 | 1,510 | 1,430 | 2,120 | 865 |
| 23 | 585 | 1,270 | 860 | 560 | 480 | 4,530 | 2,900 | 1,150 | 1,510 | 1,190 | 1,850 | 830 |
| 24 | 585 | 1,270 | 840 | 550 | 480 | 4,970 | 2,700 | 1,150 | 1,590 | 1,110 | 1,670 | 795 |
| 25 | 585 | 1,270 | 830 | 550 | 480 | 5,440 | 2,400 | 1,150 | 2,210 | 1,040 | 1,430 | 760 |
| 26 | 585 | 1,190 | 810 | 540 | 480 | 6,040 | 2,300 | 1,110 | 2,500 | 1,510 | 1,350 | 760 |
| 27 | 690 | 1,110 | 780 | 535 | 480 | 5,800 | 2,210 | 1,000 | 2,500 | 1,590 | 1,190 | 725 |
| 28 | 1,270 | 1,110 | 760 | 530 | 480 | 5,200 | 2,120 | 935 | 2,300 | 1,590 | 1,040 | 725 |
| 29 | 1,510 | 1,110 | 750 | 520 | ..... | 4,310 | 2,120 | 865 | 2,210 | 1,590 | 1,000 | 725 |
| 30 | 1,430 | 935 | 740 | 520 | ..... | 3,870 | 1,940 | 795 | 2,030 | 1,590 | 1,000 | 725 |
| 31 | 1,430 | ..... | 725 | 515 | ..... | 3,430 | ..... | 760 | ..... | 3,210 | 970 | ..... |

*Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 785 | 3,260 | 1,430 | 585 | 690 | 620 | 8,010 | 2,680 | 1,380 | 4,530 | 855 | 685 |
| 2 | 1,000 | 2,970 | 1,430 | 600 | 690 | 620 | 7,490 | 2,500 | 1,560 | 4,310 | 855 | 655 |
| 3 | 1,120 | 2,500 | 1,430 | 620 | 710 | 620 | 7,230 | 2,300 | 1,660 | 3,460 | 820 | 625 |
| 4 | 1,040 | 2,500 | 1,430 | 550 | 725 | 620 | 6,480 | 2,120 | 1,380 | 3,760 | 785 | 598 |
| 5 | 1,170 | 2,300 | 1,350 | 480 | 725 | 620 | 5,300 | 2,020 | 1,380 | 3,560 | 685 | 598 |
| 6 | 1,210 | 2,120 | 1,350 | 500 | 725 | 640 | 4,640 | 1,840 | 1,210 | 3,160 | 685 | 598 |
| 7 | 1,300 | 2,120 | 1,350 | 515 | 725 | 655 | 4,200 | 1,740 | 1,120 | 2,970 | 655 | 598 |
| 8 | 1,250 | 2,020 | 1,350 | 515 | 725 | 670 | 3,560 | 1,660 | 1,120 | 2,680 | 685 | 570 |
| 9 | 1,170 | 4,310 | 1,270 | 515 | 725 | 690 | 3,360 | 1,560 | 1,120 | 2,400 | 718 | 570 |
| 10 | 1,080 | 5,880 | 1,270 | 530 | 725 | 725 | 3,060 | 1,480 | 1,250 | 2,120 | 685 | 490 |
| 11 | 1,080 | 8,240 | 1,270 | 550 | 725 | 760 | 2,880 | 2,210 | 1,380 | 1,920 | 655 | 570 |
| 12 | 1,080 | 7,760 | 1,190 | 550 | 725 | 850 | 2,880 | 2,680 | 1,560 | 1,740 | 685 | 718 |
| 13 | 965 | 5,540 | 1,190 | 550 | 725 | 935 | 2,880 | 2,210 | 1,480 | 1,920 | 685 | 750 |
| 14 | 965 | 4,310 | 1,150 | 550 | 725 | 970 | 2,880 | 1,840 | 1,380 | 3,660 | 685 | 785 |
| 15 | 965 | 3,660 | 1,080 | 550 | 725 | 1,000 | 2,780 | 1,560 | 1,480 | 3,660 | 655 | 785 |
| 16 | 928 | 3,660 | 1,040 | 600 | 725 | 1,150 | 2,680 | 1,480 | 2,590 | 2,880 | 655 | 785 |
| 17 | 890 | 3,560 | 1,000 | 655 | 710 | 1,270 | 2,590 | 1,480 | 3,360 | 2,300 | 625 | 785 |
| 18 | 890 | 3,260 | 970 | 655 | 690 | 1,510 | 2,500 | 1,380 | 3,160 | 2,120 | 625 | 750 |
| 19 | 890 | 2,880 | 985 | 655 | 690 | 1,760 | 2,400 | 1,380 | 2,590 | 1,920 | 598 | 750 |
| 20 | 890 | 2,680 | 1,000 | 670 | 690 | 2,030 | 2,400 | 1,480 | 2,210 | 1,740 | 598 | 785 |
| 21 | 890 | 2,500 | 1,000 | 690 | 670 | 2,300 | 2,590 | 1,480 | 1,920 | 1,560 | 685 | 750 |
| 22 | 890 | 2,120 | 1,000 | 690 | 655 | 2,800 | 2,780 | 1,480 | 2,120 | 1,380 | 820 | 750 |
| 23 | 890 | 2,400 | 900 | 690 | 655 | 3,540 | 3,060 | 1,920 | 1,840 | 1,300 | 965 | 750 |
| 24 | 890 | 2,120 | 795 | 690 | 655 | 4,530 | 3,360 | 1,660 | 1,480 | 1,210 | 890 | 750 |
| 25 | 890 | 1,920 | 740 | 690 | 655 | 6,550 | 3,360 | 2,400 | 1,300 | 1,120 | 820 | 718 |
| 26 | 890 | 1,560 | 690 | 670 | 655 | 8,400 | 3,260 | 2,120 | 1,210 | 1,080 | 785 | 685 |
| 27 | 1,000 | 1,560 | 655 | 655 | 640 | 12,900 | 3,260 | 2,020 | 1,380 | 1,000 | 750 | 655 |
| 28 | 1,120 | 1,660 | 620 | 670 | 620 | 13,100 | 3,160 | 1,840 | 2,210 | 928 | 718 | 625 |
| 29 | 1,480 | 1,510 | 620 | 690 | 620 | 11,600 | 3,060 | 1,660 | 3,660 | 820 | 685 | 598 |
| 30 | 1,480 | 1,510 | 620 | 690 | ..... | 10,700 | 2,880 | 1,480 | 4,530 | 890 | 685 | 598 |
| 31 | 1,920 | ..... | 600 | 690 | ..... | 8,960 | ..... | 1,380 | ..... | 855 | 685 | ..... |

*Monthly discharge of Chippewa River near Bruce, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,600 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,510 | 480 | 679 | 0.424 | 0.49 |
| November | 2,900 | 935 | 1,530 | .956 | 1.07 |
| December | 900 | 725 | 866 | .541 | .62 |
| January | 725 | 515 | 616 | .385 | .44 |
| February | 515 | 460 | 478 | .299 | .31 |
| March | 6,040 | 480 | 2,230 | 1.39 | 1.60 |
| April | 8,120 | 1,940 | 3,820 | 2.39 | 2.67 |
| May | 2,400 | 760 | 1,520 | .950 | 1.10 |
| June | 2,500 | 795 | 1,330 | .831 | .93 |
| July | 5,560 | 1,040 | 2,340 | 1.46 | 1.68 |
| August | 4,200 | 970 | 2,120 | 1.32 | 1.52 |
| September | 1,080 | 655 | 799 | .499 | .56 |
| The year | 8,120 | 460 | 1,530 | .956 | 12.99 |
| 1919–20. | | | | | |
| October | 1,920 | 785 | 1,060 | .666 | .77 |
| November | 8,240 | 1,510 | 3,150 | 1.97 | 2.20 |
| December | 1,430 | 600 | 1,060 | .661 | .76 |
| January | 690 | 480 | 610 | .381 | .44 |
| February | 725 | 620 | 694 | .434 | .47 |
| March | 13,100 | 620 | 3,360 | 2.10 | 2.41 |
| April | 8,010 | 2,400 | 3,700 | 2.31 | 2.58 |
| May | 2,680 | 1,380 | 1,840 | 1.15 | 1.33 |
| June | 4,536 | 1,120 | 1,870 | 1.17 | 1.30 |
| July | 4,530 | 820 | 2,220 | 1.39 | 1.60 |
| August | 965 | 598 | 722 | .451 | .52 |
| September | 785 | 490 | 678 | .424 | .47 |
| The year | 13,100 | 480 | 1,750 | 1.09 | 14.85 |

*Days of deficiency in discharge of Chippewa River near Bruce, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 300 | ..... | ..... | 1 | 1 | ..... | ..... | 2 | 0.1 |
| 370 | ..... | ..... | 40 | 32 | ..... | ..... | 72 | 3.3 |
| 440 | ..... | ..... | 84 | 67 | ..... | ..... | 151 | 6.9 |
| 510 | ..... | ..... | 106 | 109 | 35 | 3 | 253 | 11.5 |
| 580 | 56 | 38 | 134 | 138 | 60 | 14 | 440 | 20.1 |
| 650 | 76 | 70 | 151 | 183 | 85 | 43 | 608 | 27.7 |
| 720 | 110 | 80 | 163 | 204 | 106 | 101 | 764 | 34.9 |
| 790 | 133 | 91 | 168 | 220 | 121 | 133 | 866 | 39.5 |
| 860 | 162 | 120 | 179 | 233 | 145 | 142 | 981 | 44.8 |
| 930 | 179 | 144 | 192 | 242 | 169 | 157 | 1,083 | 49.4 |
| 1,000 | 208 | 155 | 204 | 255 | 182 | 165 | 1,169 | 53.3 |
| 1,070 | 218 | 173 | 226 | 262 | 188 | 175 | 1,242 | 56.7 |
| 1,140 | 224 | 178 | 232 | 270 | 197 | 185 | 1,286 | 58.7 |
| 1,210 | 233 | 191 | 241 | 281 | 204 | 192 | 1,342 | 61.2 |
| 1,280 | 236 | 199 | 248 | 288 | 215 | 202 | 1,388 | 63.3 |
| 1,350 | 246 | 201 | 256 | 297 | 222 | 205 | 1,427 | 65.1 |
| 1,420 | 249 | 205 | 260 | 298 | 222 | 218 | 1,452 | 66.2 |
| 1,490 | 257 | 215 | 264 | 302 | 237 | 234 | 1,509 | 68.8 |
| 1,575 | 265 | 220 | 274 | 309 | 247 | 245 | 1,560 | 71.2 |
| 1,700 | 270 | 222 | 279 | 319 | 262 | 250 | 1,602 | 73.1 |
| 2,000 | 279 | 243 | 299 | 328 | 279 | 265 | 1,693 | 77.2 |
| 5,000 | 359 | 329 | 359 | 355 | 352 | 350 | 2,104 | 96.0 |
| 7,500 | 365 | 346 | 365 | 361 | 363 | 357 | 2,157 | 98.4 |
| 10,000 | ..... | 361 | ..... | 365 | 365 | 362 | 2,183 | 99.6 |
| 14,000 | ..... | 366 | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 1,500 | 2,080 | 1,280 | 1,090 | 1,530 | 1,750 | ..... | ..... |
| Maximum (sec.-ft.) | 5,880 | 13,100 | 7,000 | 9,240 | 8,120 | 1,310 | ..... | ..... |
| Minimum (sec.-ft.) | [a] 510 | 518 | 282 | 260 | 460 | 480 | ..... | ..... |

[a] Approximate.

### CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

LOCATION.—In SE. ¼ sec. 6, T. 28 N., R. 8 W., at highway bridge at Chippewa Falls, Chippewa County, 2,500 feet below mouth of Duncan Creek, which comes in from right.

DRAINAGE AREA.—5,600 square miles.

RECORDS AVAILABLE.—June 22, 1888, to September 30, 1920. The station was originally established by Chippewa Lumber & Boom Co., which has kept a continuous record since 1889. Since 1904 United States Weather Bureau has obtained gage readings during the flood season of each year. On June 1, 1906, the United States Geological Survey began making measurements and obtaining gage readings.

GAGE.—On July 27, 1916, a Gurley water-stage recorder was installed in place of a Friez water-stage recorder which had been in operation since January, 1914, on web between cushing piers supporting first right-hand span, about 10 feet upstream from gage formerly used by United States Weather Bureau; gage referred to original datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel; fairly permanent. Both banks high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, is not known, but probably occurred during period April 13–18, the discharge amounting to about 45,000 second-feet; minimum stage recorded, about 0.10 foot at 2 p. m. September 14 (discharge, 680 second-feet); caused by regulation at Wissota dam.

Maximum stage recorded during year ending September 30, 1920, 17.0 feet about 1 p. m. March 27 (discharge, 78,000 second-feet); minimum stage, −0.15 foot at 6 p. m. January 25 (discharge, estimated 374 second-feet); caused by regulation at Wissota dam.

1888–1920: Maximum stage recorded, 26.03 feet December 6, 1896 (discharge not determined on account of effect of ice jam); minimum discharge recorded, about 40 second-feet February 4, 1917 (caused by regulation at Wissota dam).

A stage of 26.94 feet was reached September 10, 1884; discharge not determined.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Flow past station controlled to considerable extent by operation of the gates at the Wissota power plant of Wisconsin, Minnesota Light & Power Co., a short distance above gage. Large diurnal fluctuation.

ACCURACY.—Stage-discharge relation changed during flood of latter part of March, 1920; affected by ice December 29, 1918, January 1–10 and February 5–8, 1919, and December 11, 1919, to March 24, 1920. Rating curve used during 1919 and 1920, prior to flood of March, 1920, well defined between 530 and 56,200 second-feet; poorly defined below 530 second-feet. Discharge measurements made after the March flood indicate that the control had lowered 0.1 foot and a rating curve parallel to and 0.1 foot lower than the 1919 curve has been used since the March flood. Continuous gage-height record obtained from water-stage recorder except for periods noted in footnote to tables of daily discharge. Daily discharge ascertained by means of discharge integrator, except as indicated in footnote to tables of daily discharge. Open-water records for periods when water-stage recorder was operating, good; other records fair.

*Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 8[a] | W. G. Hoyt | 2.93 | 4,410 | Jan. 6 | J. W. Harris | 1.95 | 4,170 |
| 23 | R. S. Huffman | 1.05 | 2,540 | Feb. 7 | ....do | 1.81 | 4,800 |
| Feb. 21 | ....do | 1.19 | 2,990 | Mar. 29 | S. B. Soulé | 14.41 | 58,400 |
| July 3 | S. B. Soulé | [b] 2.61 | 8,020 | June 12 | W. G. Hoyt | 1.23 | 3,390 |
| [redacted] 5 | ....do | 3.02 | 7,530 | 13 | ....do | 1.96 | 4,930 |
| Dec. 4[c] | W. G. Hoyt | 1.62 | 4,000 | Sept. 30 | S. B. Soulé | 1.61 | 4,150 |

[a] Ice jam at railroad bridge below gage and at bridge from which measurement was made.
[b] Stage fluctuated very rapidly; measured flow does not correspond to flow from rating curve based on constant-stage measurements.
[c] Possibly some backwater from ice downstream.

*Daily discharge, in second-feet, of Chippewa River at Chippewa Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 2,360 | 6,620 | 1,890 | 2,700 | 2,720 | 2,260 | | 5,820 | 3,020 | 5,850 | 8,280 | 950 |
| 2 | 2,710 | 5,980 | 2,340 | 3,500 | 1,740 | 1,850 | | 6,980 | 2,540 | 5,630 | 10,200 | 1,610 |
| 3 | 2,520 | 7,040 | 2,750 | 3,800 | 2,740 | 2,400 | 12,000 | 7,980 | 3,360 | 4,760 | 8,420 | 2,160 |
| 4 | 2,490 | 5,800 | 2,350 | 4,300 | 3,020 | 2,270 | | 6,120 | 4,010 | 1,760 | 9,610 | 2,860 |
| 5 | 2,580 | 5,450 | 2,300 | 2,800 | 2,200 | 2,310 | | 9,060 | 4,320 | 8,140 | 7,670 | 3,280 |
| 6 | 1,840 | 5,300 | 2,290 | 3,100 | 2,200 | 2,350 | 9,160 | 8,630 | 3,800 | 15,100 | 8,170 | 2,440 |
| 7 | 2,100 | 5,720 | 2,760 | 3,800 | 2,100 | 2,300 | 13,700 | 8,280 | 3,320 | 15,700 | 10,800 | 1,040 |
| 8 | 2,600 | 7,500 | 2,500 | 4,400 | 2,200 | 2,290 | 17,900 | 8,930 | 2,100 | 14,400 | 11,600 | 1,530 |
| 9 | 2,840 | 15,600 | 4,180 | 4,000 | 1,420 | 2,670 | 25,100 | 10,300 | 4,140 | 12,400 | 10,400 | 2,550 |
| 10 | 2,360 | 11,300 | 3,820 | 4,000 | 1,940 | 2,680 | 25,600 | 6,310 | 3,900 | 10,700 | 7,250 | 2,580 |
| 11 | 2,260 | 11,700 | 3,020 | 2,080 | 2,020 | 2,640 | 31,800 | 7,640 | 5,380 | 8,210 | 8,020 | 2,690 |
| 12 | 2,940 | 12,100 | 2,830 | 1,920 | 2,050 | 2,760 | 31,800 | 7,140 | 5,920 | 8,380 | 5,560 | 2,610 |
| 13 | 2,020 | 8,300 | 3,560 | 1,920 | 2,390 | 3,280 | | 5,450 | 5,760 | 5,880 | 4,090 | 2,220 |
| 14 | 2,880 | 6,260 | 4,120 | 3,410 | 2,500 | 2,640 | | 5,640 | 4,280 | 7,210 | 3,400 | 1,100 |
| 15 | 3,540 | 6,500 | 2,260 | 3,170 | 2,350 | 2,500 | | 5,280 | 2,110 | 7,130 | 5,660 | 1,860 |
| | | | | | | | 35,000 | | | | | |
| 16 | 3,680 | 6,700 | 4,100 | 2,940 | 1,440 | 1,900 | | 4,860 | 3,420 | 6,650 | 5,730 | 2,270 |
| 17 | 3,620 | 6,800 | 4,130 | 2,630 | 2,200 | 3,200 | | 4,410 | 5,200 | 6,870 | 4,330 | 2,060 |
| 18 | 3,210 | 6,300 | 4,940 | 2,340 | 2,110 | | | 7,040 | 5,180 | 6,440 | 7,580 | 2,180 |
| 19 | 2,920 | 5,500 | 4,830 | 2,030 | 2,110 | | 21,300 | 7,100 | 6,370 | 4,790 | 5,380 | 2,400 |
| 20 | 1,940 | 4,500 | 4,780 | 2,240 | 2,110 | | 11,900 | 7,840 | 5,110 | 2,350 | 4,920 | 2,220 |
| | | | | | | 15,000 | | | | | | |
| 21 | 2,260 | 3,300 | 4,720 | 2,820 | 2,160 | | 13,100 | 6,170 | 6,960 | 5,100 | 5,890 | 1,120 |
| 22 | 2,370 | 3,000 | 3,460 | 2,910 | 2,210 | | 12,000 | 5,570 | 6,440 | 5,380 | 5,300 | 2,150 |
| 23 | 2,880 | 2,400 | 7,720 | 2,280 | 1,580 | 21,500 | 10,500 | 5,520 | 6,840 | 4,540 | 5,630 | 2,780 |
| 24 | 2,860 | 2,950 | 7,410 | 2,950 | 2,560 | 21,800 | 9,500 | 4,800 | 6,740 | 3,790 | 2,160 | 2,860 |
| 25 | 2,900 | 2,500 | 7,740 | 2,960 | 2,330 | 21,800 | 9,700 | 4,780 | 6,840 | 3,670 | 5,260 | 2,890 |
| 26 | 3,160 | 3,590 | 7,840 | 1,520 | 2,280 | 22,200 | 8,730 | 5,460 | 9,880 | 4,010 | 4,460 | 2,860 |
| 27 | 2,540 | 4,800 | 6,950 | 2,110 | 2,220 | 21,500 | 7,320 | 5,630 | 9,560 | 2,220 | 3,450 | 2,530 |
| 28 | 2,920 | 3,230 | 6,600 | 2,590 | 2,220 | 20,400 | 8,880 | 4,720 | 7,910 | 5,760 | 3,020 | 1,620 |
| 29 | 5,380 | 2,970 | 2,600 | 2,090 | ..... | 22,200 | 8,210 | 5,690 | 6,540 | 7,230 | 3,010 | 3,130 |
| 30 | 6,360 | 3,300 | 5,520 | 2,330 | ..... | 18,000 | 6,900 | 3,600 | 7,260 | 6,320 | 4,780 | 3,190 |
| 31 | 6,300 | ..... | 4,720 | 2,310 | ..... | 18,000 | ..... | 5,080 | ..... | 8,120 | 2,570 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 3,090 | 6,880 | 4,500 | 2,370 | 1,120 | 1,850 | 38,400 | 8,600 | 6,770 | 17,400 | 1,480 | 3,100 |
| 2 | 2,850 | 7,540 | 5,700 | 2,720 | 2,590 | 2,220 | 31,600 | 6,540 | 4,800 | 17,500 | 2,290 | 1,920 |
| 3 | 3,350 | 10,500 | 5,500 | 3,080 | 2,740 | 2,260 | 27,400 | 9,640 | 5,100 | 14,000 | 2,690 | 2,020 |
| 4 | 3,640 | 7,410 | 5,500 | 1,490 | 2,780 | 2,280 | 21,600 | 7,520 | 4,020 | 11,800 | 1,760 | 2,080 |
| 5 | 1,900 | 8,360 | 5,300 | 1,910 | 2,790 | 2,500 | 20,100 | 6,360 | 1,720 | 11,000 | 2,830 | 1,450 |
| 6 | 3,500 | 8,560 | 5,000 | 2,650 | 2,420 | 2,060 | 16,700 | 6,610 | 2,000 | 9,300 | 2,610 | 1,180 |
| 7 | 3,800 | 8,440 | 3,000 | 2,250 | 2,160 | 1,000 | 13,700 | 6,320 | 3,500 | 7,360 | 1,660 | 1,820 |
| 8 | 4,000 | 7,720 | 4,000 | 1,720 | 1,120 | 2,190 | 12,500 | 6,020 | 6,400 | 7,300 | 1,440 | 1,900 |
| 9 | 3,700 | 4,610 | 4,800 | 1,700 | 2,440 | 2,220 | 11,000 | 4,560 | 6,100 | 6,480 | 2,310 | 1,780 |
| 10 | 3,500 | 6,790 | 3,620 | 1,920 | 2,510 | 2,320 | 9,500 | 7,140 | 5,800 | 5,660 | 2,400 | 1,260 |
| 11 | 2,600 | 16,700 | 3,520 | 1,040 | 2,380 | 2,350 | 7,620 | 7,900 | 5,600 | 3,820 | 1,860 | 1,250 |
| 12 | 1,790 | 15,400 | 3,510 | 2,030 | 2,320 | 2,340 | 10,600 | 10,600 | 6,200 | 7,160 | 1,980 | 1,240 |
| 13 | 2,520 | 14,200 | 3,400 | 2,160 | 2,490 | 2,400 | 9,500 | 10,000 | 5,880 | 4,940 | 1,860 | 1,760 |
| 14 | 3,160 | 13,000 | 1,720 | 1,830 | 2,720 | 1,170 | 9,000 | 9,040 | 6,000 | 8,260 | 1,820 | 1,800 |
| 15 | 3,100 | 11,800 | 3,330 | 1,780 | 1,840 | 2,300 | 8,330 | 6,920 | 4,900 | 8,060 | 1,480 | 1,800 |
| 16 | 3,110 | 10,800 | 3,820 | 1,980 | 3,230 | 2,680 | 8,370 | 4,860 | 10,100 | 8,020 | 2,820 | 1,650 |
| 17 | 2,940 | 13,400 | 2,740 | 1,960 | 2,260 | 2,910 | 7,120 | 7,820 | 16,900 | 6,450 | 3,320 | 1,730 |
| 18 | 2,650 | 11,100 | 2,280 | 1,200 | 2,240 | 3,560 | 5,710 | 6,780 | 18,000 | 3,400 | 3,460 | 1,440 |
| 19 | 1,710 | 9,720 | 3,110 | 2,120 | 2,200 | 4,270 | 9,540 | 6,640 | 15,200 | 6,760 | 3,860 | 1,150 |
| 20 | 2,510 | 5,900 | 2,300 | 2,540 | 2,220 | 4,020 | 8,400 | 6,550 | 10,900 | 5,520 | 3,720 | 1,640 |
| 21 | 2,740 | 9,160 | 1,830 | 1,820 | 1,900 | 1,200 | 7,330 | 6,280 | 10,700 | 5,060 | 3,880 | 2,410 |
| 22 | 2,690 | 3,710 | 2,420 | 3,150 | 1,230 | 4,780 | 8,060 | 6,200 | 6,260 | 3,460 | 1,780 | 3,520 |
| 23 | 2,860 | 7,200 | 3,240 | 3,080 | 2,040 | 6,050 | 9,540 | 2,800 | 6,810 | 3,180 | 3,690 | 3,850 |
| 24 | 3,280 | 9,100 | 2,720 | 3,020 | 2,260 | 9,350 | 13,000 | 11,500 | 5,820 | 3,800 | 3,690 | 3,850 |
| 25 | 3,040 | 6,190 | 1,060 | 1,000 | 2,180 | 44,100 | 15,200 | 8,130 | 3,490 | 1,950 | 3,640 | 2,600 |
| 26 | 1,800 | 6,850 | 2,310 | 2,820 | 2,140 | 49,100 | 16,200 | 7,600 | 4,960 | 2,260 | 3,850 | 1,200 |
| 27 | 4,590 | 6,800 | 2,930 | 3,190 | 2,560 | 66,200 | 12,900 | 6,080 | 3,320 | 2,270 | 3,680 | 1,500 |
| 28 | 5,140 | 6,600 | 1,120 | 3,290 | 2,550 | 63,200 | 12,900 | 5,740 | 6,100 | 2,400 | 3,840 | 2,400 |
| 29 | 3,760 | 6,300 | 2,210 | 3,150 | 1,000 | 59,000 | 11,900 | 5,260 | 11,100 | 2,130 | 1,920 | 2,400 |
| 30 | 4,840 | 3,800 | 2,970 | 3,200 | ..... | 52,000 | 9,880 | 2,690 | 16,300 | 1,870 | 3,760 | 2,300 |
| 31 | 5,800 | ..... | 2,090 | 3,200 | ..... | 44,800 | ..... | 4,490 | ..... | 1,600 | 4,190 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 29, 1918, Jan. 1–10, Feb. 5–8, 1919, and Dec. 11, 1919, to Mar. 24, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Recording gage not in perfect operation, Nov. 8, 9, 16–23, 1918, Mar. 15–22, 30, 31, 1919, Apr. 1–5, 13–18, Oct. 6–10, Nov. 12–14, 27–30, 1919, May 22, 23, June 6–12, July 10, 29–30, and Sept. 11, 18, 25–30, 1920; discharge partially estimated or interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 5,600 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 6,360 | 1,840 | 3,010 | 0.538 | 0.62 |
| November | 15,600 | 2,400 | 6,100 | 1.09 | 1.22 |
| December | 7,840 | 1,890 | 4,230 | .755 | .87 |
| January | 4,400 | 1,520 | 2,840 | .507 | .58 |
| February | 3,020 | 1,420 | 2,180 | .389 | .41 |
| March | 22,200 | 1,850 | 9,810 | 1.75 | 2.02 |
| April | ..... | 6,900 | 18,400 | 3.29 | 3.67 |
| May | 10,300 | 3,600 | 6,380 | 1.14 | 1.31 |
| June | 9,880 | 2,100 | 5,270 | .941 | 1.05 |
| July | 15,700 | 1,760 | 6,920 | 1.24 | 1.43 |
| August | 11,600 | 2,160 | 6,210 | 1.11 | 1.28 |
| September | 3,280 | 950 | 2,260 | .404 | .45 |
| The year | ..... | 950 | 6,150 | 1.10 | 14.91 |
| 1919–20. | | | | | |
| October | 5,800 | 1,710 | 3,220 | .575 | .66 |
| November | 16,700 | 3,710 | 8,820 | 1.58 | 1.76 |
| December | 5,700 | 1,060 | 3,280 | .586 | .68 |
| January | 3,290 | 1,000 | 2,300 | .411 | .47 |
| February | 3,230 | 1,000 | 2,220 | .396 | .43 |
| March | 66,200 | 1,000 | 14,500 | 2.59 | 2.99 |
| April | 38,400 | 5,710 | 13,500 | 2.41 | 2.69 |
| May | 11,500 | 2,690 | 6,880 | 1.23 | 1.42 |
| June | 18,000 | 1,720 | 7,360 | 1.31 | 1.46 |
| July | 17,500 | 1,600 | 6,460 | 1.15 | 1.33 |
| August | 4,190 | 1,440 | 2,760 | .493 | .57 |
| September | 3,850 | 1,150 | 2,000 | .357 | .40 |
| The year | 66,200 | 1,000 | 6,100 | 1.09 | 14.86 |

*Days of deficiency in discharge of Chippewa River at Chippewa Falls, Wis., for the years ending Sept. 30, 1914–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | | Oct. 1, 1913, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|---|
| | 1913–14 | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 400 | ..... | ..... | ..... | 23 | 2 | ..... | ..... | 25 | 1.0 |
| 800 | ..... | ..... | ..... | 41 | 3 | ..... | ..... | 44 | 1.7 |
| 1,000 | ..... | ..... | 3 | 57 | 11 | 1 | ..... | 72 | 2.8 |
| 1,200 | ..... | ..... | 5 | 63 | 27 | 4 | 11 | 110 | 4.3 |
| 1,400 | ..... | 31 | 8 | 75 | 61 | 4 | 18 | 197 | 7.7 |
| 1,700 | 50 | 51 | 16 | 103 | 102 | 11 | 29 | 362 | 14.2 |
| 2,000 | 95 | 87 | 35 | 130 | 126 | 22 | 65 | 560 | 21.9 |
| 2,300 | 102 | 106 | 67 | 152 | 154 | 65 | 94 | 740 | 28.9 |
| 2,600 | 109 | 135 | 100 | 171 | 165 | 99 | 123 | 902 | 35.3 |
| 2,900 | 121 | 168 | 128 | 189 | 192 | 128 | 146 | 1,072 | 41.9 |
| 3,200 | 122 | 180 | 150 | 223 | 207 | 148 | 165 | 1,195 | 46.7 |
| 3,500 | 129 | 195 | 163 | 234 | 223 | 162 | 180 | 1,286 | 50.3 |
| 4,000 | 156 | 215 | 192 | 250 | 238 | 177 | 209 | 1,437 | 56.2 |
| 4,500 | 182 | 233 | 199 | 275 | 259 | 193 | 217 | 1,558 | 60.9 |
| 5,000 | 205 | 247 | 209 | 290 | 271 | 208 | 228 | 1,658 | 64.8 |
| 6,000 | 239 | 256 | 226 | 306 | 295 | 246 | 247 | 1,815 | 71.0 |
| 7,000 | 280 | 269 | 242 | 314 | 317 | 273 | 278 | 1,973 | 77.2 |
| 8,000 | 294 | 281 | 253 | 318 | 329 | 293 | 293 | 2,061 | 80.6 |
| 9,000 | 303 | 293 | 263 | 324 | 333 | 308 | 305 | 2,129 | 83.3 |
| 10,000 | 312 | 302 | 274 | 330 | 340 | 315 | 318 | 2,191 | 85.7 |
| 14,000 | 338 | 341 | 314 | 342 | 350 | 335 | 341 | 2,361 | 92.3 |
| 18,000 | 347 | 355 | 331 | 358 | 353 | 347 | 353 | 2,444 | 95.6 |
| 25,000 | 355 | 365 | 346 | 365 | 357 | 355 | 356 | 2,499 | 97.7 |
| 40,000 | 365 | ..... | 363 | ..... | 365 | 365 | 359 | 2,547 | 99.6 |
| 80,000 | ..... | ..... | 366 | ..... | ..... | ..... | 366 | 2,557 | 100.0 |
| Mean discharge (sec.-ft.) | 5,990 | 5,310 | 7,470 | 4,090 | 4,520 | 6,150 | 6,100 | ..... | ..... |
| Maximum (sec.-ft.) | 33,900 | 23,700 | 52,100 | 23,300 | ..... | ..... | 66,200 | ..... | ..... |
| Minimum (sec.-ft.) | [a] 1,580 | [a] 1,300 | 800 | 40 | 175 | 950 | 1,000 | ..... | ..... |

[a] Approximate.

### FLAMBEAU RIVER NEAR BUTTERNUT, WIS.

LOCATION.—In NW. ¼ SE. ¼ sec. 33, T. 41 N., R. 1 E., 6 miles southeast of Butternut, Ashland County, and 7 miles upstream from Park Falls.

DRAINAGE AREA.—660 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1920.

GAGE.—Chain gage supported by built-up cantilever, attached to posts set in right bank of river; installed May 26, 1916; read by Mrs. Samuel Holt, jr. Vertical staff gage at same site and datum was used from July 30, 1914, until taken out by ice in spring of 1916.

DISCHARGE MEASUREMENTS.—Made from a cable 1,500 feet downstream from gage.

CHANNEL AND CONTROL.—Bed at gage composed of mud and rock. Left bank is low and subject to overflow; right bank slopes back gradually to high-water mark. At cable site, 1,500 feet below gage, the bed is rocky and banks high. Control is at head of Schultz Rapids, 200 feet below cable and 1,700 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 6.2 feet at 9 a. m. July 7 (discharge, 2,840 second-feet); minimum stage recorded, 1.45 feet at 7 a. m. and 6 p. m. October 26 (discharge, 316 second-feet).

Maximum stage recorded during year ending September 30, 1920, 6.38 feet June 12 (discharge, 3,000 second-feet); minimum stage recorded, 0.90 foot August 27 and 28 (discharge, 204 second-feet).

1914–1920: Maximum stage recorded, 9.0 feet April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum stage recorded, 0.90 foot August 27 and 28, 1920 (discharge, 204 second-feet).

REGULATION.—Storage reservoirs are maintained by Chippewa & Flambeau Improvement Co. on headwaters of Flambeau River. Of these reservoirs, Rest Lake, in sec. 9, T. 42 N., R. 5 E., with an allowable capacity of about 1½ billion cubic feet, is the largest.

ACCURACY.—Stage-discharge relation permanent except as affected by ice November 20, 1918, to April 1, 1919, and December 14, 1919, to March 26, 1920. One rating curve used; well defined between 356 and 3,480 second-feet. Gage read to quarter-tenths twice daily during open-water period; and every other day during winter period. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, discharge measurements, observer's notes, and weather records, and except for days when gage was not read, for which it was interpolated. Open-water records good; winter records fair.

*Discharge measurements of Flambeau River near Butternut, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 20[a] | R. S. Huffman | 2.05 | 380 | Jan. 12[a] | J. W. Harris | 2.82 | 551 |
| Feb. 18[a] | do | 2.10 | 336 | Feb. 14[b] | do | 2.90 | 428 |
| Mar. 13[a] | do | 2.44 | 361 | | | | |
| June 29 | S. B. Soulé | 3.22 | 1,030 | | | | |
| Dec. 12[a] | J. W. Harris | 2.63 | 742 | | | | |

[a] Complete ice cover at measuring section; incomplete ice cover at control.
[b] Complete ice cover at measuring section and at control.

*Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 356 | 483 | 355 | 430 | 370 | 330 | 985 | 1,080 | 673 | 1,380 | 1,380 | 592 |
| 2 | 329 | 483 | 355 | 415 | 360 | 330 | 805 | 1,080 | 632 | 1,870 | 1,280 | 554 |
| 3 | 329 | 483 | 340 | 415 | 360 | 330 | 716 | 985 | 592 | 1,940 | 1,280 | 554 |
| 4 | 356 | 466 | 355 | 415 | 355 | 330 | 716 | 1,030 | 632 | 2,000 | 1,170 | 518 |
| 5 | 385 | 483 | 370 | 415 | 355 | 330 | 716 | 985 | 632 | 2,140 | 1,120 | 483 |
| 6 | 432 | 554 | 385 | 410 | 350 | 335 | 895 | 895 | 632 | 2,630 | 1,080 | 518 |
| 7 | 466 | 632 | 400 | 410 | 350 | 340 | 895 | 985 | 805 | 2,840 | 985 | 500 |
| 8 | 554 | 632 | 430 | 400 | 345 | 345 | 1,030 | 895 | 805 | 2,560 | 985 | 483 |
| 9 | 592 | 632 | 450 | 400 | 340 | 350 | 1,220 | 985 | 850 | 2,140 | 940 | 483 |
| 10 | 592 | 632 | 465 | 400 | 340 | 355 | 1,330 | 895 | 805 | 2,070 | 940 | 483 |
| 11 | 554 | 632 | 485 | 390 | 340 | 360 | 1,870 | 805 | 850 | 1,870 | 895 | 466 |
| 12 | 554 | 592 | 520 | 390 | 340 | 360 | 1,870 | 850 | 895 | 1,740 | 805 | 449 |
| 13 | 554 | 554 | 520 | 390 | 330 | 360 | 2,000 | 805 | 895 | 1,500 | 760 | 449 |
| 14 | 554 | 554 | 520 | 385 | 330 | 370 | 2,000 | 805 | 940 | 1,500 | 760 | 449 |
| 15 | 554 | 518 | 535 | 385 | 330 | 385 | 1,870 | 716 | 895 | 1,380 | 716 | 449 |
| 16 | 483 | 483 | 535 | 385 | 330 | 400 | 1,870 | 805 | 895 | 1,280 | 716 | 449 |
| 17 | 483 | 483 | 555 | 385 | 335 | 430 | 1,870 | 895 | 985 | 1,080 | 716 | 449 |
| 18 | 483 | 449 | 555 | 380 | 335 | 450 | 1,740 | 895 | 985 | 1,080 | 716 | 416 |
| 19 | 483 | 356 | 535 | 380 | 340 | 485 | 1,740 | 850 | 1,080 | 1,030 | 673 | 385 |
| 20 | 483 | 370 | 535 | 380 | 340 | 520 | 1,620 | 760 | 1,080 | 985 | 632 | 385 |
| 21 | 483 | 385 | 555 | 375 | 340 | 575 | 1,560 | 716 | 1,080 | 985 | 632 | 385 |
| 22 | 416 | 385 | 555 | 375 | 345 | 630 | 1,560 | 716 | 1,120 | 985 | 673 | 449 |
| 23 | 400 | 400 | 575 | 375 | 350 | 715 | 1,500 | 673 | 1,080 | 985 | 673 | 554 |
| 24 | 370 | 400 | 575 | 370 | 355 | 805 | 1,500 | 716 | 1,170 | 895 | 632 | 518 |
| 25 | 329 | 400 | 555 | 370 | 355 | 895 | 1,380 | 632 | 1,120 | 850 | 632 | 554 |
| 26 | 316 | 400 | 555 | 370 | 350 | 940 | 1,330 | 673 | 1,170 | 895 | 592 | 483 |
| 27 | 329 | 385 | 520 | 370 | 340 | 1,010 | 1,330 | 716 | 1,220 | 895 | 554 | 518 |
| 28 | 416 | 385 | 500 | 370 | 330 | 1,030 | 1,170 | 632 | 1,170 | 985 | 554 | 554 |
| 29 | 483 | 385 | 485 | 370 | ..... | 1,030 | 1,170 | 673 | 985 | 1,080 | 554 | 592 |
| 30 | 518 | 370 | 465 | 370 | ..... | 1,030 | 1,080 | 673 | 895 | 1,380 | 592 | 592 |
| 31 | 554 | ..... | 450 | 370 | ..... | 1,030 | ..... | 716 | ..... | 1,500 | 632 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 592 | 805 | 674 | 555 | 460 | 415 | 2,560 | 1,170 | 940 | 2,070 | 632 | 304 |
| 2 | 632 | 805 | 632 | 555 | 455 | 415 | 2,350 | 1,080 | 985 | 1,870 | 592 | 280 |
| 3 | 632 | 850 | 718 | 555 | 450 | 400 | 2,210 | 1,080 | 1,080 | 1,680 | 554 | 269 |
| 4 | 632 | 805 | 805 | 555 | 430 | 400 | 2,140 | 1,030 | 1,120 | 1,740 | 554 | 269 |
| 5 | 632 | 850 | 718 | 555 | 415 | 400 | 2,000 | 940 | 1,440 | 1,620 | 483 | 269 |
| 6 | 632 | 850 | 632 | 555 | 430 | 400 | 1,870 | 940 | 1,660 | 1,440 | 483 | 280 |
| 7 | 673 | 805 | 716 | 555 | 450 | 385 | 1,680 | 895 | 1,870 | 1,280 | 466 | 292 |
| 8 | 716 | 805 | 716 | 555 | 440 | 385 | 1,380 | 895 | 2,280 | 1,080 | 416 | 304 |
| 9 | 716 | 805 | 716 | 555 | 430 | 385 | 1,280 | 895 | 2,330 | 985 | 483 | 304 |
| 10 | 760 | 895 | 674 | 555 | 430 | 385 | 1,220 | 850 | 2,370 | 985 | 483 | 342 |
| 11 | 805 | 895 | 632 | 555 | 430 | 385 | 1,170 | 850 | 2,420 | 895 | 554 | 342 |
| 12 | 716 | 1,170 | 632 | 555 | 430 | 400 | 1,170 | 895 | 3,000 | 850 | 483 | 342 |
| 13 | 554 | 1,440 | 632 | 555 | 430 | 415 | 1,170 | 895 | 2,630 | 805 | 483 | 356 |
| 14 | 483 | 1,560 | 630 | 555 | 430 | 430 | 1,170 | 895 | 1,740 | 760 | 432 | 370 |
| 15 | 483 | 1,740 | 630 | 520 | 430 | 450 | 1,080 | 850 | 1,080 | 760 | 432 | 416 |
| 16 | 483 | 1,740 | 630 | 485 | 430 | 450 | 1,080 | 805 | 1,030 | 716 | 466 | 432 |
| 17 | 483 | 1,680 | 630 | 485 | 430 | 465 | 1,030 | 805 | 985 | 673 | 449 | 466 |
| 18 | 483 | 1,560 | 590 | 485 | 430 | 485 | 1,030 | 716 | 940 | 632 | 416 | 466 |
| 19 | 483 | 1,330 | 590 | 485 | 430 | 485 | 1,080 | 632 | 895 | 632 | 400 | 483 |
| 20 | 483 | 1,280 | 590 | 485 | 430 | 520 | 1,080 | 716 | 850 | 632 | 400 | 483 |
| 21 | 483 | 1,170 | 590 | 475 | 430 | 555 | 1,030 | 760 | 805 | 673 | 416 | 449 |
| 22 | 483 | 985 | 590 | 465 | 430 | 590 | 940 | 805 | 805 | 716 | 385 | 449 |
| 23 | 483 | 895 | 590 | 475 | 415 | 805 | 805 | 895 | 760 | 716 | 356 | 432 |
| 24 | 483 | 805 | 590 | 485 | 415 | 1,280 | 760 | 985 | 716 | 716 | 292 | 416 |
| 25 | 538 | 805 | 590 | 475 | 415 | 1,560 | 716 | 1,030 | 716 | 716 | 280 | 432 |
| 26 | 592 | 805 | 590 | 465 | 415 | 1,800 | 805 | 985 | 716 | 716 | 238 | 432 |
| 27 | 592 | 760 | 590 | 465 | 415 | 2,000 | 895 | 895 | 1,120 | 716 | 204 | 416 |
| 28 | 632 | 716 | 590 | 465 | 415 | 2,560 | 985 | 805 | 1,620 | 673 | 204 | 400 |
| 29 | 632 | 716 | 590 | 465 | 415 | 2,630 | 985 | 805 | 2,000 | 673 | 280 | 416 |
| 30 | 673 | 716 | 590 | 465 | ..... | 2,700 | 1,080 | 805 | 2,280 | 632 | 304 | 416 |
| 31 | 716 | ..... | 555 | 460 | ..... | 2,840 | ..... | 850 | ..... | 592 | 316 | ..... |

NOTE.—Discharge interpolated on account of lack of gage readings, July 1, 3, Sept. 7, Oct. 25, Nov. 25, 27, Dec. 1, 3, 5, 8, 10, 12, 1919, Mar. 29 and June 6, 9, 10, 1920.

*Monthly discharge of Flambeau River near Butternut, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 660 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 592 | 316 | 458 | 0.694 | 0.80 |
| November | 632 | 356 | 479 | .726 | .81 |
| December | 575 | 340 | 484 | .733 | .85 |
| January | 430 | 370 | 389 | .589 | .68 |
| February | 370 | 330 | 344 | .521 | .54 |
| March | 1,030 | 330 | 554 | .839 | .97 |
| April | 2,000 | 716 | 1,380 | 2.09 | 2.33 |
| May | 1,080 | 632 | 824 | 1.25 | 1.44 |
| June | 1,220 | 592 | 919 | 1.39 | 1.55 |
| July | 2,840 | 850 | 1,500 | 2.27 | 2.62 |
| August | 1,380 | 554 | 815 | 1.23 | 1.42 |
| September | 592 | 385 | 490 | .742 | .83 |
| The year | 2,840 | 316 | 721 | 1.09 | 14.84 |
| 1919–20. | | | | | |
| October | 805 | 483 | 593 | .898 | 1.04 |
| November | 1,740 | 716 | 1,030 | 1.57 | 1.75 |
| December | 805 | 555 | 633 | .959 | 1.11 |
| January | 555 | 460 | 512 | .776 | .89 |
| February | 460 | 415 | 429 | .650 | .70 |
| March | 2,840 | 385 | 896 | 1.36 | 1.57 |
| April | 2,560 | 716 | 1,290 | 1.96 | 2.19 |
| May | 1,170 | 632 | 885 | 1.34 | 1.54 |
| June | 3,000 | 716 | 1,440 | 2.18 | 2.43 |
| July | 2,070 | 592 | 956 | 1.45 | 1.67 |
| August | 632 | 204 | 417 | .632 | .73 |
| September | 483 | 269 | 378 | .573 | .64 |
| The year | 3,000 | 204 | 788 | 1.19 | 16.26 |

*Days of deficiency in discharge of Flambeau River near Butternut, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 225 | ..... | ..... | ..... | ..... | ..... | 2 | 2 | 0.1 |
| 250 | ..... | ..... | ..... | ..... | ..... | 3 | 3 | .1 |
| 275 | ..... | ..... | ..... | 25 | ..... | 6 | 31 | 1.4 |
| 300 | ..... | ..... | ..... | 41 | ..... | 12 | 53 | 2.4 |
| 325 | ..... | ..... | ..... | 70 | 1 | 17 | 88 | 4.0 |
| 350 | ..... | ..... | 2 | 83 | 36 | 20 | 141 | 6.4 |
| 375 | ..... | ..... | 23 | 93 | 69 | 23 | 208 | 9.4 |
| 400 | 70 | ..... | 56 | 106 | 100 | 29 | 361 | 16.5 |
| 425 | 85 | ..... | 79 | 136 | 109 | 56 | 465 | 21.2 |
| 450 | 124 | 1 | 99 | 154 | 124 | 83 | 585 | 26.7 |
| 475 | 134 | 6 | 104 | 180 | 129 | 101 | 654 | 29.8 |
| 500 | 144 | 25 | 110 | 190 | 152 | 131 | 752 | 34.3 |
| 525 | 144 | 42 | 125 | 202 | 163 | 133 | 809 | 36.9 |
| 550 | 144 | 46 | 128 | 205 | 167 | 134 | 824 | 37.6 |
| 600 | 153 | 67 | 166 | 257 | 203 | 173 | 1,019 | 46.5 |
| 650 | 164 | 86 | 183 | 285 | 220 | 195 | 1,133 | 51.7 |
| 700 | 185 | 108 | 196 | 299 | 228 | 203 | 1,219 | 55.6 |
| 800 | 234 | 183 | 226 | 314 | 245 | 235 | 1,437 | 65.6 |
| 900 | 272 | 221 | 263 | 335 | 277 | 281 | 1,649 | 75.2 |
| 1,050 | 295 | 244 | 301 | 347 | 304 | 300 | 1,791 | 81.7 |
| 1,300 | 325 | 299 | 350 | 354 | 329 | 325 | 1,982 | 90.4 |
| 1,600 | 344 | 323 | 365 | 363 | 344 | 333 | 2,072 | 94.5 |
| 2,100 | 357 | 344 | ..... | 365 | 360 | 351 | 2,142 | 97.7 |
| 2,800 | 364 | 351 | ..... | ..... | 364 | 364 | 2,173 | 99.1 |
| 4,000 | 365 | 360 | ..... | ..... | 365 | 366 | 2,186 | 99.7 |
| 6,500 | ..... | 366 | ..... | ..... | ..... | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 772 | 1,040 | 718 | 547 | 721 | 788 | ..... | ..... |
| Maximum (sec.-ft.) | 2,840 | 5,430 | 1,380 | 1,680 | 2,840 | 3,000 | ..... | ..... |
| Mean (sec.-ft.) | [a] 375 | 449 | 340 | 250 | 316 | 204 | ..... | ..... |

[a] Approximate.

### FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at H. J. Cornelissen's farm, 6 miles by road northeast of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, which comes in from left, and 28 miles above mouth of river.

DRAINAGE AREA.—1,940 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1920. From February 15, 1903, to December 2, 1906, records were collected at a station in city of Ladysmith, three-quarters of a mile south of Minneapolis, St. Paul & Sault Ste. Marie Railway station, half a mile below dam of Menasha Pulp Co., and 6 miles below present station.

GAGE.—Chain gage fastened to a cantilever arm, supported by two posts on left bank of river, on farm of H. J. Cornelissen; read by H. J. Cornelissen.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; free from vegetation; practically permanent. At gage section, channel is divided by a small sandy island; at cable section the river flows in one channel. Banks are medium high, wooded, and not subject to overflow. Control not well defined; formed by channel below gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year ending September 30, 1919, 7.3 feet April 12 (discharge, 9,800 second-feet); minimum discharge, estimated 650 second-feet March 5 (stage-discharge relation affected by ice).

Maximum discharge during year ending September 30, 1920, estimated 12,000 second-feet, March 31; minimum stage recorded, 1.40 feet August 28–30, and September 7–9 (discharge, 500 second-feet).

1903–1906 and 1914–1920: Maximum discharge recorded, 17,400 second-feet April 23, 1916; minimum discharge, 390 second-feet December 4, 1904.

ICE.—Stage-discharge relation seriously affected by large quantities of frazil ice which form on the falls and rapids above station and fill the channel for a distance of several miles from the gage to pond of paper company's dam at Ladysmith.

REGULATION.—Chippewa & Flambeau Improvement Co. operates storage reservoirs on Rest Lake and smaller reservoirs on Manitowish and Turtle rivers and Bear Creek. These reservoirs have an effective capacity of 1.15 billion cubic feet. Weekly fluctuations at gage are caused by operation of power plants at Park Falls and storage reservoirs. No daily fluctuation has been observed.

ACCURACY.—Stage-discharge relation changed during flood of latter part of March, 1920; affected by ice November 24, 1918, to March 29, 1919, and November 13, 1919, to March 28, 1920; affected by logs at times. One rating curve used; well defined between 770 and 17,000 second-feet, extended beyond these limits; this rating curve was used direct during periods October 1, 1918, to November 12, 1919, and June 1 to September 30, 1920; indirect method for shifting control used April 24 to May 31, 1920. Gage read to quarter-tenths once daily except during winter and during periods April 23 to August 10, 1920, when it was read every other day, and March 28 to April 22, 1920, when no gage readings were obtained on account of gage having been destroyed by flood of March 28. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records excellent prior to flood of March, 1920, and fair subsequent to that time; winter records fair.

*Discharge measurements of Flambeau River near Ladysmith, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 11 [a] | R. S. Huffman | 5.12 | 962 | Jan. 17 [c] | J. W. Harris | 5.48 | 931 |
| Feb. 10 [a] | do | 4.50 | 765 | Feb. 18 [d] | do | 5.18 | 739 |
| Mar. 5 [a] | do | 4.40 | 652 | Apr. 23 | S. B. Soulé | 4.32 | 3,650 |
| June 30 | S. B. Soulé | 3.08 | 1,790 | June 14 | W. G. Hoyt | 3.26 | 1,890 |
| Dec. 13 [b] | J. W. Harris | 6.91 | 1,470 | | | | |

[a] Complete ice cover at control and measuring section.
[b] Complete ice cover; ice conditions such that accurate measurement of flow was impossible; use results with caution.
[c] Complete ice cover; results poor.
[d] Complete ice cover; best ice-measurement, but none too good.

*Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 1,000 | 3,180 | 2,510 | 1,620 | 920 | 685 | 4,140 | 5,210 | 1,560 | 1,790 | 3,800 | 1,160 |
| 2 | 1,340 | 2,770 | 2,490 | 1,500 | 920 | 680 | 3,180 | 6,000 | 1,560 | 1,910 | 3,480 | 1,160 |
| 3 | 1,200 | 2,640 | 2,480 | 1,400 | 920 | 670 | 2,390 | 3,480 | 1,560 | 1,450 | 3,040 | 1,080 |
| 4 | 1,340 | 2,640 | 2,470 | 1,290 | 895 | 660 | 2,270 | 3,180 | 1,450 | 4,140 | 2,900 | 1,080 |
| 5 | 1,560 | 2,510 | 2,470 | 1,200 | 870 | 650 | 2,900 | 3,480 | 1,240 | 5,600 | 2,900 | 1,080 |
| 6 | 1,450 | 2,640 | 2,490 | 1,160 | 840 | 655 | 2,900 | 3,800 | 1,240 | 6,220 | 2,900 | 1,080 |
| 7 | 1,450 | 2,900 | 2,510 | 1,080 | 820 | 660 | 2,900 | 6,000 | 1,240 | 6,900 | 3,040 | 1,080 |
| 8 | 1,240 | 5,400 | 2,550 | 1,040 | 795 | 670 | 3,800 | 2,900 | 1,500 | 6,000 | 2,900 | 1,080 |
| 9 | 2,390 | 5,210 | 2,600 | 1,000 | 770 | 680 | 3,800 | 2,770 | 1,560 | 4,840 | 2,900 | 1,000 |
| 10 | 2,270 | 5,020 | 2,640 | 980 | 765 | 685 | 4,840 | 2,390 | 1,790 | 4,660 | 2,510 | 1,000 |
| 11 | 2,390 | 4,660 | 2,660 | 960 | 760 | 685 | 7,380 | 2,030 | 1,910 | 4,140 | 2,270 | 1,000 |
| 12 | 1,910 | 4,480 | 2,670 | 960 | 755 | 685 | 9,800 | 1,910 | 1,910 | 3,800 | 2,270 | 1,000 |
| 13 | 2,510 | 3,480 | 2,680 | 960 | 750 | 685 | 8,960 | 1,910 | 1,670 | 3,180 | 2,030 | 1,000 |
| 14 | 2,390 | 3,480 | 2,700 | 960 | 745 | 710 | 8,140 | 1,500 | 1,790 | 3,180 | 2,030 | 920 |
| 15 | 2,390 | 2,900 | 2,720 | 960 | 740 | 770 | 7,880 | 1,670 | 1,910 | 2,900 | 2,030 | 920 |
| 16 | 2,150 | 2,900 | 2,750 | 960 | 735 | 880 | 6,440 | 1,670 | 1,790 | 2,390 | 2,150 | 920 |
| 17 | 2,150 | 2,900 | 2,770 | 960 | 730 | 1,040 | 5,600 | 2,150 | 1,910 | 2,390 | 2,150 | 920 |
| 18 | 1,910 | 2,900 | 2,750 | 960 | 720 | 1,200 | 5,210 | 2,150 | 1,910 | 2,270 | 2,030 | 920 |
| 19 | 1,910 | 2,900 | 2,720 | 960 | 715 | 1,400 | 3,800 | 2,270 | 1,910 | 2,150 | 2,030 | 960 |
| 20 | 1,910 | 2,900 | 2,700 | 960 | 710 | 1,670 | 4,310 | 2,150 | 2,030 | 2,030 | 1,790 | 920 |
| 21 | 2,150 | 2,640 | 2,680 | 950 | 710 | 1,970 | 5,210 | 2,150 | 2,390 | 2,030 | 1,790 | 1,120 |
| 22 | 1,790 | 2,640 | 2,660 | 940 | 710 | 2,330 | 4,480 | 1,910 | 2,390 | 2,030 | 1,790 | 1,080 |
| 23 | 2,030 | 2,640 | 2,640 | 935 | 710 | 2,640 | 4,840 | 1,910 | 2,390 | 2,030 | 1,790 | 1,160 |
| 24 | 2,150 | 2,640 | 2,580 | 930 | 710 | 3,040 | 4,480 | 1,910 | 2,510 | 2,030 | 1,670 | 1,080 |
| 25 | 1,910 | 2,610 | 2,510 | 920 | 710 | 3,640 | 4,480 | 1,910 | 2,640 | 1,910 | 1,670 | 1,080 |
| 26 | 1,910 | 2,580 | 2,390 | 920 | 705 | 4,310 | 4,480 | 2,510 | 2,640 | 2,390 | 1,560 | 1,080 |
| 27 | 1,910 | 2,560 | 2,270 | 920 | 705 | 4,930 | 4,480 | 1,910 | 2,640 | 3,800 | 1,400 | 1,080 |
| 28 | 2,390 | 2,540 | 2,150 | 920 | 700 | 5,120 | 4,480 | 2,030 | 2,640 | 3,800 | 1,290 | 1,080 |
| 29 | 2,390 | 2,520 | 1,970 | 920 | ..... | 4,930 | 4,480 | 2,150 | 2,510 | 3,480 | 1,290 | 1,120 |
| 30 | 3,040 | 2,510 | 1,850 | 920 | ..... | 4,480 | 4,660 | 1,670 | 1,790 | 3,480 | 1,200 | 1,160 |
| 31 | 3,040 | ..... | 1,730 | 920 | ..... | 3,480 | ..... | 1,620 | ..... | 3,970 | 1,200 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 1,340 | 2,150 | 2,030 | 1,200 | 960 | 750 | 10,100 | 3,330 | 4,480 | 4,140 | 1,140 | 660 |
| 2 | 1,560 | 2,270 | 1,910 | 1,200 | 960 | 750 | 8,100 | 2,770 | 4,480 | 4,140 | 1,120 | 710 |
| 3 | 1,670 | 2,640 | 1,910 | 1,200 | 920 | 750 | 7,300 | 2,700 | 3,690 | 3,970 | 1,100 | 710 |
| 4 | 1,790 | 2,640 | 1,790 | 1,160 | 880 | 750 | 6,600 | 2,640 | 2,900 | 3,800 | 1,080 | 685 |
| 5 | 1,620 | 2,510 | 1,670 | 1,160 | 980 | 750 | 5,600 | 2,640 | 2,580 | 3,350 | 1,020 | 685 |
| 6 | 1,560 | 2,390 | 1,670 | 1,120 | 1,080 | 750 | 4,900 | 2,640 | 2,270 | 2,900 | 960 | 620 |
| 7 | 1,560 | 2,270 | 1,620 | 1,080 | 1,060 | 750 | 4,500 | 2,460 | 2,090 | 2,770 | 900 | 500 |
| 8 | 1,670 | 2,390 | 1,560 | 1,080 | 1,040 | 750 | 4,000 | 2,270 | 1,910 | 2,640 | 840 | 500 |
| 9 | 1,560 | 2,390 | 1,500 | 1,080 | 860 | 760 | 3,800 | 2,210 | 1,680 | 2,700 | 880 | 500 |
| 10 | 1,560 | 2,030 | 1,500 | 1,080 | 675 | 770 | 3,600 | 2,150 | 1,450 | 2,770 | 920 | 540 |
| 11 | 1,560 | 5,210 | 1,500 | 1,040 | 880 | 805 | 3,600 | 2,150 | 1,680 | 2,340 | 920 | 685 |
| 12 | 1,450 | 4,840 | 1,500 | 1,040 | 1,080 | 805 | 3,600 | 2,150 | 1,910 | 1,910 | 1,040 | 740 |
| 13 | 1,450 | 4,480 | 1,470 | 1,000 | 1,080 | 840 | 3,600 | 1,970 | 1,910 | 2,280 | 1,040 | 620 |
| 14 | 1,450 | 4,480 | 1,450 | 1,000 | 1,080 | 840 | 3,600 | 1,790 | 1,910 | 2,640 | 1,000 | 580 |
| 15 | 1,450 | 4,310 | 1,400 | 960 | 980 | 880 | 3,600 | 1,850 | 2,700 | 2,340 | 880 | 600 |
| 16 | 1,500 | 4,310 | 1,340 | 960 | 880 | 880 | 3,600 | 1,910 | 3,480 | 2,030 | 880 | 620 |
| 17 | 1,040 | 4,140 | 1,340 | 930 | 810 | 920 | 3,500 | 1,740 | 2,690 | 1,850 | 660 | 710 |
| 18 | 1,120 | 4,140 | 1,290 | 940 | 740 | 960 | 3,450 | 1,560 | 2,900 | 1,670 | 840 | 740 |
| 19 | 1,120 | 3,970 | 1,240 | 960 | 700 | 960 | 3,350 | 1,450 | 2,840 | 1,500 | 840 | 740 |
| 20 | 770 | 3,800 | 1,240 | 880 | 740 | 1,040 | 3,300 | 1,340 | 2,770 | 1,340 | 840 | 740 |
| 21 | 770 | 3,640 | 1,240 | 805 | 740 | 1,340 | 3,200 | 1,680 | 2,580 | 1,130 | 805 | 740 |
| 22 | 1,160 | 3,330 | 1,240 | 820 | 740 | 1,790 | 3,200 | 2,030 | 2,390 | 920 | 805 | 740 |
| 23 | 1,160 | 3,180 | 1,240 | 840 | 740 | 2,270 | 3,640 | 1,970 | 2,210 | 1,130 | 880 | 740 |
| 24 | 1,450 | 3,040 | 1,240 | 860 | 745 | 2,640 | 4,150 | 1,910 | 2,030 | 1,340 | 600 | 710 |
| 25 | 1,560 | 2,770 | 1,240 | 880 | 745 | 3,040 | 4,660 | 2,030 | 1,850 | 1,160 | 770 | 660 |
| 26 | 1,560 | 2,640 | 1,240 | 900 | 745 | 3,480 | 4,750 | 2,150 | 1,670 | 965 | 660 | 710 |
| 27 | 1,790 | 2,510 | 1,240 | 920 | 745 | 3,970 | 4,840 | 1,580 | 1,790 | 770 | 580 | 710 |
| 28 | 1,790 | 2,270 | 1,240 | 920 | 745 | 4,480 | 4,010 | 1,000 | 1,910 | 985 | 500 | 710 |
| 29 | 1,790 | 2,150 | 1,240 | 920 | 745 | 6,100 | 3,180 | 2,570 | 2,780 | 1,200 | 500 | 710 |
| 30 | 1,910 | 2,030 | 1,240 | 940 | ..... | 8,800 | 3,160 | 4,140 | 3,640 | 1,180 | 500 | 685 |
| 31 | 1,910 | ..... | 1,240 | 960 | ..... | 12,000 | ..... | 4,140 | ..... | 1,160 | 620 | ..... |

NOTE.—Stage-discharge relation affected by ice, Nov. 24, 1918, to Mar. 29, 1919, and Nov. 13, 1919, to Mar. 28, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Gage readings in error May 15 and 16, 1919, on account of logs in river; discharge estimated. Gage not read, Mar. 29 to Apr. 22, 1920; discharge ascertained by comparison with flow of Flambeau River near Butternut, Wis., and Chippewa River near Bruce, Wis. Gage not read, Apr. 24, 26, 28-30, May 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, June 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, July 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 26, 28, 30, and Aug. 1, 3, 5, 7, 9, 1920; discharge interpolated.

*Monthly discharge of Flambeau River near Ladysmith, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,940 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 3,040 | 1,000 | 1,990 | 1.03 | 1.19 |
| November | 5,400 | 2,510 | 3,140 | 1.62 | 1.81 |
| December | 2,770 | 1,730 | 2,510 | 1.29 | 1.49 |
| January | 1,620 | 920 | 1,030 | .531 | .61 |
| February | 920 | 700 | 769 | .396 | .41 |
| March | 5,120 | 650 | 1,850 | .954 | 1.10 |
| April | 9,800 | 2,270 | 4,890 | 2.52 | 2.81 |
| May | 6,000 | 1,500 | 2,590 | 1.34 | 1.54 |
| June | 2,640 | 1,240 | 1,930 | .995 | 1.11 |
| July | 6,900 | 1,450 | 3,320 | 1.71 | 1.97 |
| August | 3,800 | 1,200 | 2,190 | 1.13 | 1.30 |
| September | 1,160 | 920 | 1,040 | .536 | .60 |
| The year | 9,800 | 650 | 2,280 | 1.18 | 15.94 |
| 1919–20. | | | | | |
| October | 1,910 | 770 | 1,470 | .758 | .87 |
| November | 5,210 | 2,030 | 3,160 | 1.63 | 1.82 |
| December | 2,030 | 1,240 | 1,440 | .742 | .86 |
| January | 1,200 | 805 | 995 | .513 | .59 |
| February | 1,080 | 675 | 865 | .446 | .43 |
| March | 12,000 | 750 | 2,140 | 1.10 | 1.27 |
| April | 10,100 | 3,160 | 4,420 | 2.28 | 2.54 |
| May | 4,140 | 1,000 | 2,220 | 1.14 | 1.31 |
| June | 4,480 | 1,450 | 2,510 | 1.29 | 1.44 |
| July | 4,140 | 770 | 2,100 | 1.08 | 1.24 |
| August | 1,140 | 500 | 843 | .435 | .50 |
| September | 740 | 500 | 667 | .344 | .38 |
| The year | 12,000 | 500 | 1,900 | .979 | 13.30 |

*Days of deficiency in discharge of Flambeau River near Ladysmith, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 300 | 0 | ..... | ..... | ..... | ..... | ..... | 0 | 0.0 |
| 500 | 20 | ..... | ..... | 0 | ..... | 0 | 20 | .9 |
| 600 | 20 | ..... | 0 | 47 | 0 | 8 | 75 | 3.4 |
| 700 | 62 | 0 | 67 | 95 | 14 | 23 | 261 | 11.9 |
| 800 | 73 | 1 | 82 | 111 | 36 | 65 | 368 | 16.8 |
| 900 | 104 | 4 | 109 | 153 | 41 | 92 | 503 | 22.9 |
| 1,000 | 116 | 9 | 145 | 191 | 80 | 118 | 659 | 30.1 |
| 1,200 | 149 | 47 | 169 | 224 | 107 | 155 | 851 | 38.8 |
| 1,500 | 211 | 124 | 197 | 273 | 126 | 190 | 1,121 | 51.0 |
| 1,800 | 246 | 174 | 231 | 308 | 152 | 227 | 1,338 | 61.0 |
| 2,000 | 264 | 200 | 258 | 315 | 177 | 244 | 1,458 | 66.5 |
| 2,300 | 280 | 221 | 287 | 325 | 211 | 267 | 1,591 | 72.6 |
| 2,500 | 287 | 232 | 298 | 327 | 232 | 274 | 1,650 | 75.3 |
| 3,000 | 299 | 272 | 324 | 342 | 295 | 302 | 1,834 | 83.7 |
| 3,500 | 320 | 302 | 337 | 346 | 313 | 317 | 1,935 | 88.3 |
| 4,000 | 337 | 318 | 347 | 351 | 323 | 335 | 2,011 | 91.7 |
| 5,000 | 356 | 326 | 357 | 355 | 345 | 357 | 2,096 | 95.6 |
| 6,000 | 363 | 333 | 362 | 359 | 357 | 359 | 2,133 | 97.3 |
| 7,000 | 364 | 334 | 363 | 360 | 360 | 361 | 2,142 | 97.7 |
| 8,000 | 364 | 336 | 365 | 361 | 362 | 362 | 2,150 | 98.1 |
| 9,000 | 364 | 338 | ..... | 364 | 364 | 364 | 2,159 | 98.5 |
| 10,000 | 365 | 352 | ..... | 365 | 365 | 364 | 2,176 | 99.3 |
| 12,000 | ..... | 359 | ..... | ..... | ..... | 365 | 2,184 | 99.5 |
| 14,000 | ..... | 362 | ..... | ..... | ..... | 366 | 2,188 | 99.8 |
| 18,000 | ..... | 366 | ..... | ..... | ..... | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 1,780 | 2,850 | 1,690 | 1,380 | 2,280 | 1,900 | ..... | ..... |
| Maximum (sec.-ft.) | 8,240 | 17,400 | 7,880 | 9,520 | 9,800 | 12,000 | ..... | ..... |
| Minimum (sec.-ft.) | 480 | 763 | 605 | 540 | 650 | 500 | ..... | ..... |

### JUMP RIVER AT SHELDON, WIS.

LOCATION.—In sec. 26, T. 33 N., R. 5 W., at highway bridge in Sheldon, Rusk County, 11 miles above confluence with Chippewa River.

DRAINAGE AREA.—510 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.)

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1920.

GAGE.—Chain gage bolted to downstream handrail of bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel; clean and free from vegetation. Right bank high and not subject to overflow; left bank may be overflowed occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.38 feet at 5 p. m. April 11 (discharge, 6,620 second-feet); minimum discharge, estimated 25 second-feet February 1 (stage-discharge relation affected by ice).

Maximum stage recorded during year ending September 30, 1920, 11.48 feet March 26 (discharge, 12,800 second-feet); minimum stage recorded, 2.71 feet about 5 p. m. August 8 (discharge, 21 second-feet).

1915–1920: Maximum stage recorded, 11.48 feet March 26, 1920 (discharge, 12,800 second-feet); minimum discharge, about 15 second-feet February 3–7, 1918 (stage-discharge relation affected by ice).

ACCURACY.—Stage-discharge relation permanent except as affected by ice November 23, 1918, to March 24, 1919, and November 26, 1919, to March 23, 1920. Rating curve well defined between 45 and 5,930 second-feet. Gage read to quarter-tenths twice daily except during winter when it was read every other day. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

*Discharge measurements of Jump River at Sheldon, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 10[a] | R. S. Huffman | 4.25 | 183 | Jan. 19[a] | J. W. Harris | 4.10 | 88 |
| Feb. 10[a] | do | 4.08 | 64 | Feb. 19[a] | do | 4.06 | 97 |
| Mar. 6[a] | do | 4.12 | 73 | June 14 | W. G. Hoyt | 3.66 | 352 |
| July 2 | S. B. Soulé | 3.43 | 244 | | | | |
| Dec. 15[a] | J. W. Harris | 4.28 | 124 | | | | |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 176 | 680 | 180 | 430 | 25 | 95 | 1,110 | 380 | 205 | 330 | 1,200 | 122 |
| 2 | 156 | 512 | 180 | 405 | 30 | 85 | 1,110 | 575 | 458 | 200 | 840 | 98 |
| 3 | 133 | 485 | 180 | 380 | 35 | 75 | 885 | 610 | 800 | 88 | 610 | 98 |
| 4 | 133 | 458 | 180 | 355 | 30 | 80 | 1,020 | 512 | 540 | 380 | 540 | 98 |
| 5 | 140 | 485 | 180 | 330 | 30 | 85 | 1,020 | 680 | 458 | 1,620 | 1,020 | 98 |
| 6 | 160 | 485 | 180 | 305 | 40 | 75 | 1,200 | 800 | 380 | 1,860 | 1,400 | 133 |
| 7 | 160 | 1,740 | 230 | 280 | 55 | 70 | 1,620 | 885 | 330 | 1,300 | 1,300 | 172 |
| 8 | 180 | 3,100 | 255 | 230 | 60 | 70 | 3,720 | 885 | 645 | 840 | 1,020 | 172 |
| 9 | 190 | 2,950 | 280 | 205 | 70 | 90 | 3,880 | 760 | 800 | 680 | 760 | 148 |
| 10 | 225 | 2,370 | 330 | 185 | 65 | 90 | 4,710 | 575 | 930 | 512 | 540 | 133 |
| 11 | 280 | 1,740 | 380 | 160 | 70 | 105 | 6,290 | 512 | 1,020 | 405 | 405 | 112 |
| 12 | 380 | 1,300 | 430 | 130 | 70 | 105 | 5,930 | 458 | 885 | 330 | 330 | 112 |
| 13 | 330 | 1,020 | 430 | 110 | 65 | 120 | 4,200 | 405 | 610 | 270 | 305 | 105 |
| 14 | 280 | 800 | 430 | 90 | 70 | 140 | 2,950 | 330 | 430 | 255 | 405 | 140 |
| 15 | 270 | 680 | 430 | 100 | 70 | 180 | 1,980 | 280 | 305 | 305 | 430 | 108 |
| 16 | 235 | 645 | 430 | 110 | 70 | 230 | 1,620 | 645 | 720 | 380 | 380 | 88 |
| 17 | 230 | 645 | 430 | 90 | 75 | 280 | 1,300 | 1,200 | 800 | 280 | 380 | 77 |
| 18 | 205 | 680 | 450 | 70 | 75 | 380 | 1,200 | 1,110 | 800 | 190 | 355 | 77 |
| 19 | 180 | 680 | 470 | 70 | 75 | 540 | 930 | 885 | 1,020 | 160 | 330 | 77 |
| 20 | 172 | 645 | 485 | 70 | 75 | 1,300 | 1,020 | 610 | 1,860 | 122 | 270 | 88 |
| 21 | 160 | 540 | 540 | 65 | 75 | 3,400 | 930 | 512 | 1,620 | 160 | 280 | 330 |
| 22 | 156 | 485 | 1,400 | 65 | 80 | 3,720 | 930 | 430 | 930 | 133 | 280 | 405 |
| 23 | 160 | 330 | 1,510 | 70 | 90 | 3,880 | 680 | 485 | 720 | 140 | 280 | 380 |
| 24 | 148 | 280 | 1,300 | 70 | 95 | 4,040 | 680 | 680 | 1,200 | 122 | 240 | 305 |
| 25 | 119 | 230 | 1,110 | 70 | 100 | 4,200 | 512 | 610 | 2,510 | 122 | 230 | 270 |
| 26 | 68 | 230 | 930 | 65 | 100 | 3,880 | 485 | 512 | 2,370 | 190 | 190 | 220 |
| 27 | 98 | 205 | 840 | 60 | 100 | 3,880 | 405 | 405 | 1,620 | 512 | 160 | 180 |
| 28 | 485 | 205 | 680 | 60 | 100 | 2,950 | 430 | 355 | 930 | 458 | 148 | 160 |
| 29 | 1,020 | 180 | 610 | 50 | ..... | 2,370 | 380 | 305 | 540 | 430 | 140 | 200 |
| 30 | 1,020 | 180 | 540 | 40 | ..... | 1,980 | 380 | 190 | 430 | 330 | 140 | 485 |
| 31 | 840 | ..... | 485 | 35 | ..... | 1,510 | ..... | 195 | ..... | 720 | 98 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 610 | 1,860 | 265 | 75 | 155 | 65 | 4,040 | 760 | 205 | 2,950 | 48 | 45 |
| 2 | 610 | 1,620 | 250 | 90 | 160 | 60 | 3,560 | 610 | 176 | 1,860 | 36 | 48 |
| 3 | 760 | 1,300 | 230 | 80 | 170 | 50 | 2,950 | 540 | 164 | 1,860 | 36 | 39 |
| 4 | 610 | 1,300 | 220 | 70 | 175 | 50 | 2,240 | 485 | 152 | 1,200 | 28 | 39 |
| 5 | 540 | 1,200 | 205 | 65 | 180 | 45 | 1,980 | 405 | 144 | 512 | 28 | 42 |
| 6 | 485 | 1,110 | 190 | 60 | 180 | 45 | 1,740 | 355 | 130 | 430 | 39 | 42 |
| 7 | 430 | 1,020 | 170 | 70 | 180 | 40 | 1,400 | 355 | 130 | 355 | 48 | 40 |
| 8 | 330 | 930 | 165 | 75 | 180 | 45 | 1,110 | 330 | 130 | 280 | 24 | 39 |
| 9 | 330 | 930 | 155 | 75 | 185 | 70 | 930 | 305 | 133 | 305 | 27 | 36 |
| 10 | 330 | 2,370 | 150 | 75 | 160 | 100 | 885 | 280 | 148 | 275 | 32 | 36 |
| 11 | 330 | 4,710 | 145 | 75 | 130 | 135 | 930 | 512 | 180 | 240 | 39 | 42 |
| 12 | 280 | 4,040 | 140 | 75 | 125 | 175 | 1,020 | 1,020 | 255 | 225 | 42 | 50 |
| 13 | 280 | 2,800 | 135 | 90 | 120 | 230 | 1,020 | 1,110 | 330 | 225 | 42 | 50 |
| 14 | 305 | 1,980 | 130 | 100 | 115 | 305 | 840 | 930 | 380 | 205 | 42 | 39 |
| 15 | 280 | 1,400 | 120 | 95 | 110 | 380 | 840 | 610 | 405 | 168 | 36 | 32 |
| 16 | 280 | 1,200 | 100 | 90 | 120 | 460 | 760 | 540 | 2,110 | 136 | 36 | 65 |
| 17 | 280 | 930 | 80 | 90 | 130 | 610 | 680 | 458 | 4,370 | 88 | 40 | 62 |
| 18 | 270 | 840 | 70 | 90 | 115 | 760 | 680 | 355 | 3,720 | 102 | 40 | 60 |
| 19 | 280 | 680 | 65 | 90 | 100 | 930 | 645 | 380 | 2,110 | 102 | 36 | 62 |
| 20 | 305 | 575 | 80 | 90 | 100 | 1,200 | 575 | 380 | 1,300 | 98 | 39 | 70 |
| 21 | 330 | 540 | 100 | 100 | 95 | 1,620 | 575 | 330 | 1,200 | 62 | 36 | 80 |
| 22 | 405 | 540 | 90 | 105 | 95 | 1,980 | 575 | 485 | 760 | 42 | 28 | 94 |
| 23 | 380 | 485 | 75 | 110 | 90 | 2,650 | 760 | 1,020 | 512 | 38 | 36 | 74 |
| 24 | 380 | 485 | 60 | 120 | 90 | 6,660 | 2,650 | 1,110 | 430 | 44 | 36 | 65 |
| 25 | 430 | 430 | 45 | 120 | 85 | 9,600 | 2,240 | 840 | 330 | 80 | 36 | 60 |
| 26 | 380 | 405 | 50 | 125 | 80 | 12,800 | 1,860 | 645 | 275 | 58 | 39 | 65 |
| 27 | 485 | 380 | 60 | 130 | 75 | 11,200 | 1,620 | 512 | 275 | 50 | 36 | 65 |
| 28 | 485 | 330 | 50 | 130 | 75 | 9,600 | 1,380 | 405 | 405 | 44 | 36 | 62 |
| 29 | 458 | 305 | 45 | 140 | 70 | 8,400 | 1,130 | 355 | 2,650 | 62 | 36 | 50 |
| 30 | 458 | 280 | 50 | 150 | ..... | 6,470 | 885 | 305 | 3,560 | 58 | 39 | 45 |
| 31 | 380 | ..... | 60 | 150 | ..... | 4,880 | ..... | 250 | ..... | 50 | 39 | ..... |

*Monthly discharge of Jump River at Sheldon, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 510 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,020 | 68 | 274 | 0.537 | 0.62 |
| November | 3,100 | 180 | 832 | 1.63 | 1.82 |
| December | 1,510 | 180 | 532 | 1.04 | 1.20 |
| January | 430 | 35 | 153 | .300 | .35 |
| February | 100 | 25 | 67.7 | .133 | .14 |
| March | 4,200 | 70 | 1,290 | 2.53 | 2.92 |
| April | 6,290 | 380 | 1,780 | 3.49 | 3.89 |
| May | 1,200 | 190 | 573 | 1.12 | 1.29 |
| June | 2,510 | 205 | 896 | 1.76 | 1.96 |
| July | 1,860 | 88 | 446 | .875 | 1.01 |
| August | 1,400 | 98 | 484 | .949 | 1.09 |
| September | 485 | 77 | 173 | .339 | .38 |
| The year | 6,290 | 25 | 627 | 1.23 | 16.67 |
| 1919–20. | | | | | |
| October | 760 | 270 | 403 | .790 | .91 |
| November | 4,710 | 280 | 1,230 | 2.41 | 2.69 |
| December | 265 | 45 | 121 | .237 | .27 |
| January | 150 | 60 | 96.8 | .190 | .27 |
| February | 185 | 70 | 126 | .247 | .27 |
| March | 12,800 | 40 | 2,630 | 5.16 | 5.95 |
| April | 4,040 | 575 | 1,420 | 2.78 | 3.10 |
| May | 1,110 | 250 | 548 | 1.07 | 1.23 |
| June | 4,370 | 130 | 902 | 1.77 | 1.98 |
| July | 2,950 | 38 | 394 | .772 | .89 |
| August | 48 | 24 | 36.6 | .072 | .08 |
| September | 94 | 32 | 53.2 | .104 | .12 |
| The year | 12,800 | 24 | 664 | 1.30 | 17.76 |

*Days of deficiency in discharge of Jump River at Sheldon, Wis., for the years ending Sept. 30, 1916–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | Oct. 1, 1915, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|
| | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 10 | 0 | ..... | 0 | ..... | ..... | 0 | 0.0 |
| 20 | 1 | 0 | 18 | 0 | 0 | 19 | 1.0 |
| 35 | 22 | 21 | 70 | 6 | 7 | 126 | 6.9 |
| 55 | 52 | 84 | 105 | 10 | 66 | 317 | 17.4 |
| 80 | 86 | 128 | 135 | 45 | 102 | 496 | 27.1 |
| 110 | 143 | 157 | 150 | 74 | 133 | 657 | 36.0 |
| 155 | 171 | 171 | 178 | 97 | 167 | 784 | 42.9 |
| 200 | 183 | 205 | 200 | 133 | 186 | 907 | 49.6 |
| 240 | 197 | 241 | 214 | 149 | 194 | 995 | 54.5 |
| 280 | 208 | 254 | 223 | 167 | 203 | 1,055 | 57.7 |
| 320 | 215 | 271 | 230 | 173 | 218 | 1,107 | 58.6 |
| 360 | 220 | 281 | 250 | 188 | 234 | 1,173 | 64.2 |
| 400 | 223 | 294 | 253 | 200 | 243 | 1,213 | 66.4 |
| 450 | 226 | 299 | 261 | 222 | 254 | 1,262 | 69.1 |
| 500 | 229 | 306 | 277 | 238 | 265 | 1,315 | 72.0 |
| 600 | 244 | 311 | 299 | 256 | 278 | 1,388 | 76.0 |
| 700 | 255 | 314 | 311 | 277 | 289 | 1,446 | 79.2 |
| 800 | 264 | 320 | 318 | 288 | 295 | 1,485 | 81.3 |
| 1,000 | 282 | 320 | 323 | 304 | 308 | 1,537 | 84.1 |
| 2,000 | 328 | 326 | 351 | 344 | 340 | 1,689 | 92.5 |
| 4,000 | 356 | 348 | 356 | 359 | 354 | 1,773 | 97.0 |
| 6,000 | 363 | 365 | 360 | 364 | 359 | 1,811 | 99.1 |
| 8,000 | 365 | ..... | 365 | 365 | 361 | 1,821 | 99.5 |
| 10,000 | 366 | ..... | ..... | ..... | 364 | 1,825 | 99.9 |
| 12,000 | ..... | ..... | ..... | ..... | 365 | 1,826 | 99.9 |
| 14,000 | ..... | ..... | ..... | ..... | 366 | 1,827 | 100.0 |
| Mean discharge (sec.-ft.) | 727 | 359 | 488 | 627 | 664 | ..... | ..... |
| Maximum (sec.-ft.) | 8,600 | 3,880 | 7,800 | 6,290 | 12,800 | ..... | ..... |
| Minimum (sec.-ft.) | 18 | 20 | 15 | 25 | 24 | ..... | ..... |

### EAU CLAIRE RIVER NEAR AUGUSTA, WIS.

LOCATION.—In sec. 12, T. 26 N., R. 6 E., at Trouble Water bridge, 7 miles northeast of Augusta, Eau Claire County. South Fork of Eau Claire River enters from left 4 miles above station.

DRAINAGE AREA.—500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 16, 1914, to September 30, 1920.

GAGE.—Chain gage on downstream side of bridge; read by Albert Wagner and Frank Howe.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading at control about 500 feet downstream from bridge.

CHANNEL AND CONTROL.—Bed at bridge and above is sandy and very shifting. A short distance below gage the channel narrows and a rock outcrop overlain with large boulders forms the control. Banks are high and not subject to overflow. Point of zero flow, September 28, 1920, gage height, $-0.9$ foot $\pm$ 0.1 foot.

ICE.—Stage-discharge relation seriously affected by ice.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.95 feet June 25 (discharge, 5,520 second-feet); minimum discharge, 44 second-feet February 7 (determined by current-meter measurement).

Maximum stage recorded during year ending September 30, 1920, 11.98 feet at 9 a. m. March 27 (discharge, 8,720 second-feet); minimum stage recorded, 0.00 foot September 29 and 30 (discharge, 46 second-feet).

1914–1920: Maximum open-water stage recorded, 11.98 feet March 27, 1920 (discharge, 8,720 second-feet); minimum discharge, estimated 3.5 second-feet, January 27, 1918, from discharge measurement made through complete ice cover.

ACCURACY.—Stage-discharge relation changed during high water of March, 1920; affected by ice November 30, 1918, to March 19, 1919, and November 27, 1919, to March 22, 1920. Rating curve used during 1919 and 1920 prior to March 22, 1920, well defined throughout; curve used March 23 to September 30, 1920, well defined below 275 second-feet and is same as previous curve above 2,010 second-feet. Gage read to quarter-tenths once daily except during winter when it was usually read twice a week. Daily discharge ascertained by applying daily gage height to rating table, except for periods indicated in footnote to tables of daily discharge. Open-water records good; winter records poor for 1919, and fair for 1920.

*Discharge measurements of Eau Claire River near Augusta, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 7[a] | Hoyt and Huffman | 2.15 | 118 | Jan. 22[a] | J. W. Harris | 1.74 | 96 |
| Feb. 7[a] | R. S. Huffman | .80 | 44 | Feb. 24[a] | do | 1.46 | 88 |
| Mar. 3[a] | do | 1.00 | 58 | June 10 | W. G. Hoyt | .66 | 182 |
| July 6 | S. B. Soulé | .94 | 213 | Sept. 28 | S. B. Soulé | .01 | 45.8 |
| Dec. 18[a] | J. W. Harris | 1.20 | 102 | | | | |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 62 | 221 | | | | | 482 | 278 | 153 | 293 | 385 | 66 |
| 2 | 62 | 193 | | | | | 465 | 293 | 179 | 207 | 323 | 66 |
| 3 | 62 | 193 | | | | | 449 | 293 | 221 | 179 | 207 | 62 |
| 4 | 69 | 353 | | | | | 433 | 263 | 207 | 221 | 179 | 62 |
| 5 | 78 | 433 | | | | | 417 | 263 | 179 | 235 | 153 | 78 |
| 6 | 78 | 353 | | | | | 975 | 323 | 153 | 221 | 179 | 107 |
| 7 | 78 | 278 | | | | | 1,020 | 449 | 263 | 185 | 166 | 111 |
| 8 | 87 | 338 | | | | | 3,100 | 499 | 207 | 158 | 655 | 87 |
| 9 | 97 | 417 | | | | | 3,710 | 385 | 179 | 153 | 516 | 69 |
| 10 | 129 | 385 | | | | 70 | 2,780 | 323 | 166 | 141 | 278 | 73 |
| 11 | 107 | 308 | | | | | 3,260 | 278 | 166 | 129 | 221 | 87 |
| 12 | 97 | 235 | | | | | 3,100 | 235 | 207 | 118 | 179 | 78 |
| 13 | 97 | 207 | | | | | 1,870 | 207 | 166 | 111 | 153 | 69 |
| 14 | 83 | 193 | | | | | 1,270 | 193 | 141 | 118 | 153 | 66 |
| 15 | 78 | 179 | | | 100 | | 845 | 193 | 129 | 111 | 166 | 62 |
| 16 | 78 | 166 | 250 | 130 | | | 655 | 417 | 118 | 97 | 129 | 57 |
| 17 | 78 | 174 | | | | | 725 | 885 | 129 | 87 | 141 | 54 |
| 18 | 73 | 179 | | | | 2,290 | 885 | 690 | 148 | 78 | 179 | 54 |
| 19 | 69 | 193 | | | | 2,080 | 805 | 499 | 179 | 78 | 221 | 54 |
| 20 | 69 | 193 | | | | 1,940 | 765 | 385 | 235 | 73 | 179 | 51 |
| 21 | 69 | 179 | | | | 1,940 | 765 | 308 | 229 | 87 | 185 | 69 |
| 22 | 69 | 153 | | | | 1,070 | 620 | 263 | 179 | 83 | 263 | 87 |
| 23 | 73 | 141 | | | | 885 | 550 | 338 | 153 | 73 | 221 | 83 |
| 24 | 78 | 179 | | | | 765 | 466 | 533 | 2,150 | 69 | 174 | 69 |
| 25 | 78 | 193 | | | | 655 | 401 | 466 | 5,520 | 107 | 141 | 66 |
| 26 | 78 | 179 | | | | 620 | 353 | 353 | 1,450 | 111 | 118 | 54 |
| 27 | 103 | 141 | | | | 1,020 | 308 | 293 | 845 | 179 | 107 | 54 |
| 28 | 235 | 153 | | | | 620 | 293 | 249 | 585 | 129 | 87 | 54 |
| 29 | 385 | 118 | | | ..... | 550 | 278 | 193 | 369 | 111 | 78 | 69 |
| 30 | 338 | 100 | | | ..... | 550 | 249 | 179 | 323 | 97 | 73 | 148 |
| 31 | 263 | ..... | | | ..... | 482 | ..... | 153 | ..... | 148 | 69 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 148 | 1,330 | 130 | 120 | 100 | 70 | 1,100 | 430 | 260 | 2,080 | 88 | 54 |
| 2 | 118 | 765 | 130 | 95 | 100 | 75 | 1,470 | 365 | 245 | 1,200 | 79 | 54 |
| 3 | 263 | 620 | 120 | 85 | 105 | 80 | 1,890 | 335 | 217 | 745 | 79 | 54 |
| 4 | 158 | 533 | 115 | 70 | 110 | 85 | 1,530 | 290 | 204 | 518 | 79 | 54 |
| 5 | 118 | 449 | 110 | 70 | 120 | 90 | 1,200 | 260 | 190 | 1,050 | 79 | 61 |
| 6 | 118 | 417 | 105 | 75 | 120 | 95 | 970 | 217 | 177 | 350 | 79 | 54 |
| 7 | 97 | 417 | 105 | 75 | 125 | 110 | 890 | 204 | 177 | 412 | 88 | 54 |
| 8 | 91 | 433 | 105 | 80 | 130 | 125 | 710 | 217 | 164 | 448 | 88 | 54 |
| 9 | 97 | 401 | 105 | 80 | 130 | 135 | 640 | 204 | 190 | 335 | 88 | 54 |
| 10 | 87 | 765 | 105 | 85 | 135 | 140 | 605 | 185 | 185 | 275 | 79 | 54 |
| 11 | 87 | 2,640 | 105 | 95 | 140 | 155 | 588 | 2,220 | 335 | 231 | 70 | 54 |
| 12 | 78 | 2,010 | 105 | 100 | 145 | 185 | 675 | 3,100 | 320 | 190 | 79 | 70 |
| 13 | 73 | 1,070 | 105 | 100 | 135 | 235 | 588 | 1,350 | 305 | 177 | 79 | 61 |
| 14 | 78 | 765 | 105 | 100 | 125 | 295 | 518 | 1,050 | 245 | 1,150 | 70 | 61 |
| 15 | 78 | 585 | 105 | 100 | 110 | 340 | 465 | 745 | 1,340 | 675 | 70 | 61 |
| 16 | 73 | 516 | 105 | 100 | 100 | 400 | 430 | 535 | 2,440 | 350 | 61 | 61 |
| 17 | 73 | 433 | 105 | 100 | 90 | 480 | 430 | 482 | 3,530 | 290 | 61 | 61 |
| 18 | 73 | 417 | 105 | 100 | 80 | 655 | 365 | 430 | 2,220 | 217 | 61 | 54 |
| 19 | 87 | 385 | 105 | 100 | 80 | 930 | 350 | 448 | 1,010 | 177 | 54 | 54 |
| 20 | 107 | 369 | 105 | 100 | 75 | 1,390 | 335 | 745 | 675 | 164 | 54 | 54 |
| 21 | 107 | 338 | 105 | 100 | 80 | 2,640 | 350 | 815 | 482 | 152 | 54 | 54 |
| 22 | 118 | 369 | 110 | 95 | 85 | 3,260 | 350 | 745 | 482 | 140 | 54 | 54 |
| 23 | 91 | 353 | 115 | 105 | 85 | 4,750 | 605 | 2,940 | 552 | 129 | 54 | 54 |
| 24 | 87 | 323 | 115 | 105 | 85 | 6,320 | 1,950 | 3,180 | 395 | 118 | 54 | 54 |
| 25 | 153 | 293 | 115 | 105 | 85 | 6,520 | 1,150 | 1,200 | 305 | 118 | 54 | 54 |
| 26 | 323 | 141 | 120 | 105 | 85 | 6,520 | 815 | 745 | 245 | 108 | 54 | 54 |
| 27 | 263 | 130 | 130 | 105 | 80 | 8,720 | 745 | 675 | 260 | 108 | 54 | 54 |
| 28 | 221 | 130 | 130 | 105 | 75 | 4,940 | 745 | 535 | 260 | 108 | 54 | 54 |
| 29 | 207 | 130 | 135 | 100 | 70 | 2,940 | 675 | 430 | 780 | 98 | 61 | 46 |
| 30 | 179 | 130 | 140 | 100 | ..... | 2,010 | 500 | 335 | 4,750 | 88 | 54 | 46 |
| 31 | 975 | ..... | 145 | 100 | ..... | 1,530 | ..... | 305 | ..... | 88 | 54 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 30, 1918, to Mar. 19, 1919, and Nov. 27, 1919, to Mar. 22, 1920; mean discharge during former period and daily discharge during latter period, ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Discharge interpolated, Apr. 2–4, 1919, and June 15 and 16, 1920, on account of lack of gage readings. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Eau Claire River near Augusta, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 500 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 385 | 62 | 112 | 0.224 | 0.26 |
| November | 433 | 100 | 224 | .448 | .54 |
| December | ..... | ..... | 250 | .500 | .58 |
| January | ..... | ..... | 130 | .260 | .30 |
| February | ..... | ..... | 100 | .200 | .21 |
| March | 2,290 | ..... | 537 | 1.07 | 1.23 |
| April | 3,710 | 249 | 1,080 | 2.16 | 2.41 |
| May | 885 | 153 | 344 | .688 | .79 |
| June | 5,520 | 118 | 511 | 1.02 | 1.14 |
| July | 293 | 69 | 135 | .270 | .31 |
| August | 655 | 69 | 203 | .406 | .47 |
| September | 148 | 51 | 72.2 | .144 | .16 |
| The year | 5,520 | ..... | 308 | .616 | 8.40 |
| 1919–20. | | | | | |
| October | 975 | 73 | 156 | .312 | .36 |
| November | 2,640 | 130 | 589 | 1.18 | 1.32 |
| December | 145 | 105 | 114 | .228 | .26 |
| January | 120 | 70 | 95.3 | .191 | .22 |
| February | 145 | 70 | 103 | .206 | .22 |
| March | 8,720 | 70 | 1,810 | 3.62 | 4.17 |
| April | 1,950 | 335 | 788 | 1.58 | 1.76 |
| May | 3,180 | 185 | 830 | 1.66 | 1.91 |
| June | 4,750 | 164 | 765 | 1.53 | 1.71 |
| July | 2,080 | 88 | 396 | .792 | .91 |
| August | 88 | 54 | 67.3 | .135 | .16 |
| September | 70 | 46 | 55.4 | .111 | .12 |
| The year | 8,720 | 46 | 482 | .964 | 13.12 |

*Days of deficiency in discharge of Eau Claire River near Augusta, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time |
| 20 | ..... | ..... | ..... | 69 | ..... | ..... | 69 | 3.1 |
| 25 | ..... | ..... | ..... | 70 | ..... | ..... | 70 | 3.2 |
| 30 | ..... | ..... | 29 | 71 | ..... | ..... | 100 | 4.6 |
| 40 | ..... | 1 | 67 | 72 | ..... | ..... | 140 | 6.4 |
| 50 | ..... | 13 | 99 | 73 | ..... | 2 | 187 | 8.5 |
| 60 | 21 | 29 | 114 | 101 | 8 | 35 | 308 | 14.1 |
| 80 | 52 | 80 | 171 | 148 | 72 | 73 | 596 | 27.2 |
| 100 | 63 | 115 | 201 | 188 | 129 | 109 | 805 | 36.7 |
| 120 | 73 | 144 | 217 | 217 | 143 | 168 | 962 | 43.9 |
| 150 | 106 | 170 | 240 | 219 | 189 | 199 | 1,123 | 51.2 |
| 180 | 146 | 191 | 261 | 253 | 219 | 210 | 1,280 | 58.4 |
| 230 | 203 | 212 | 274 | 263 | 244 | 224 | 1,420 | 64.8 |
| 280 | 220 | 220 | 295 | 276 | 292 | 236 | 1,539 | 70.2 |
| 330 | 232 | 226 | 303 | 290 | 304 | 247 | 1,602 | 73.1 |
| 380 | 244 | 233 | 307 | 299 | 311 | 264 | 1,658 | 75.6 |
| 450 | 267 | 244 | 313 | 308 | 324 | 282 | 1,738 | 79.3 |
| 600 | 290 | 263 | 321 | 322 | 336 | 298 | 1,830 | 83.5 |
| 800 | 313 | 293 | 330 | 333 | 347 | 320 | 1,936 | 88.3 |
| 1,000 | 327 | 311 | 338 | 339 | 353 | 326 | 1,994 | 91.0 |
| 1,500 | 346 | 339 | 349 | 345 | 357 | 341 | 2,077 | 94.8 |
| 2,000 | 356 | 350 | 353 | 352 | 360 | 345 | 2,116 | 96.5 |
| 3,000 | 362 | 357 | 357 | 359 | 362 | 355 | 2,152 | 98.2 |
| 5,000 | 365 | 363 | 365 | 364 | 365 | 362 | 2,184 | 99.6 |
| 7,000 | ..... | 366 | ..... | 365 | ..... | 365 | 2,191 | 100.0 |
| 10,000 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 427 | 517 | 301 | 323 | 308 | 482 | ..... | ..... |
| Maximum (sec.-ft.) | 4,370 | 7,180 | 3,710 | 5,620 | 5,520 | 8,720 | ..... | ..... |
| Minimum (sec.-ft.) | a 56 | 40 | 25 | a 15 | a 51 | 46 | ..... | ..... |

a Approximate.

### RED CEDAR RIVER NEAR COLFAX, WIS.

LOCATION.—In sec. 27, T. 30 N., R. 11 W., at highway bridge 4½ miles north of Colfax, Dunn County. Hay River enters from right about 11 miles below station and Trout Creek, also from right, 3½ miles above.

DRAINAGE AREA.—1,100 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale 1 inch=6 miles).

RECORDS AVAILABLE.—March 19, 1914, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge; read by Andrew Lundeguam.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge, to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; small amount of grass growth during summer. Control not well defined. Left bank high and not subject to overflow; right bank medium high and may be overflowed during extreme high water.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year ending September 30, 1919, 5.0 feet at 6 p. m. March 18 (discharge, 4,450 second-feet); minimum discharge, estimated 405 second-feet February 1–10 (stage-discharge relation affected by ice).

Maximum stage recorded during year ending September 30, 1920, 6.95 feet at 8 a. m. March 26 (discharge, 7,610 second-feet); minimum discharge, estimated 490 second-feet February 25 (stage-discharge relation affected by ice).

1914–1920: Maximum stage recorded, 6.95 feet March 26, 1920 (discharge, 7,610 second-feet); minimum discharge recorded, 368 second-feet February 19, 1918 (by current-meter measurement through complete ice cover).

REGULATION.[5]—The following dams and reservoirs are used to regulate the flow of Red Cedar River. Owing to operation of these reservoirs, the flow at station is not natural.

*Reservoirs used to regulate flow of Red Cedar River.*

| Dam. | Location. | Capacity (millions of cubic feet).[a] |
|---|---|---|
| Long Lake | Sec. 24, T. 37 N., R 11 W | 400 |
| Cedar Lake | Sec. 21, T. 36 N., R. 10 W | 400 |
| Birch Lake | Sec. 25, T. 37 N., R. 10 W | 475 |
| Bear Lake | Sec. 7, T. 36 N., R. 11 W | 150 |
| | | 1,425 |

[a] Revised figures based in part on more accurate determinations from recent surveys and in part on the limiting of the allowable range of stage in the reservoirs by decisions of the Railroad Commission of Wisconsin. Storage in Chetek Lake is used for regulating flow to the power plant at the outlet.

ACCURACY.—Stage-discharge relation permanent except as affected by ice, and by growth of aquatic grass from May to September. One curve used; well defined between 653 and 4,450 second-feet; extended beyond these limits and may be in error. Gage read to quarter-tenths twice daily except during winter, when it was read every other day. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair; winter records subject to considerable error.

*Discharge measurements of Red Cedar River near Colfax, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 9[a] | R. S. Huffman | 4.32 | 561 | Jan. 7[a] | J. W. Harris | 2.7 | 667 |
| Feb. 8[a] | do | 2.22 | 414 | Feb. 9[a] | do | 3.0 | 652 |
| Mar. 4[a] | do | 2.65 | 511 | May 12 | S. B. Soulé | 2.84 | 1,830 |
| July 3[b] | S. B. Soulé | 1.34 | 529 | June 12 | W. G. Hoyt | 1.95 | 992 |
| Oct. 25 | do | 1.54 | 658 | | | | |
| Dec. 5[a] | Hoyt and Harris | 3.6 | 753 | | | | |

[a] Complete ice cover at control and measuring section.
[b] Some grass on control section near right bank.

[5] From data on file in engineering department of Railroad Commission of Wisconsin.

*Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 535 | 610 | 450 | | | | 1,120 | 720 | 662 | 512 | 750 | 635 |
| 2 | 560 | 635 | 432 | | | | 1,120 | 785 | 585 | 470 | 720 | 720 |
| 3 | 512 | 535 | | | | | 1,120 | 855 | 690 | 512 | 855 | 720 |
| 4 | 560 | 512 | | | | | 1,040 | 960 | 750 | 635 | 1,120 | 690 |
| 5 | 560 | 560 | | | | | 1,040 | 960 | 690 | 968 | 690 | 890 |
| | | | | 600 | 405 | 490 | | | | | | |
| 6 | 535 | 662 | 475 | | | | 1,040 | 1,040 | 690 | 1,300 | 785 | 820 |
| 7 | 560 | 1,040 | | | | | 1,480 | 1,040 | 690 | 1,390 | 1,480 | 785 |
| 8 | 610 | 1,000 | | | | | 2,640 | 960 | 610 | 1,210 | 1,120 | 750 |
| 9 | 585 | 890 | | | | | 2,880 | 890 | 610 | 890 | 890 | 785 |
| 10 | 610 | 720 | | | | | 2,760 | 960 | 750 | 785 | 820 | 690 |
| 11 | 635 | 662 | | | | | 2,880 | 785 | 690 | 750 | 1,040 | 585 |
| 12 | 585 | 662 | | | | | 2,640 | 785 | 820 | 662 | 855 | 662 |
| 13 | 560 | 610 | | | | | 1,880 | 750 | 750 | 662 | 855 | 635 |
| 14 | 535 | 635 | | | | | 1,580 | 720 | 662 | 820 | 890 | 585 |
| 15 | 535 | 610 | | | | 1,340 | 1,480 | 690 | 585 | 925 | 1,120 | 635 |
| | | | 540 | 700 | 570 | | | | | | | |
| 16 | 560 | 610 | | | | | 1,390 | 925 | 512 | 855 | 1,120 | 690 |
| 17 | 585 | 662 | | | | | 1,210 | 960 | 512 | 855 | 1,210 | 635 |
| 18 | 512 | 635 | | | | | 1,210 | 635 | 662 | 662 | 1,120 | 585 |
| 19 | 535 | 750 | | | | 3,380 | 1,000 | 585 | 610 | 610 | 785 | 635 |
| 20 | 512 | 690 | | | | 3,120 | 1,000 | 690 | 610 | 635 | 750 | 662 |
| 21 | 512 | 690 | | | | 3,250 | 890 | 690 | 610 | 720 | 720 | 690 |
| 22 | 585 | 635 | | | | 2,530 | 890 | 690 | 610 | 720 | 720 | 610 |
| 23 | 560 | 512 | | | | 2,090 | 855 | 690 | 635 | 720 | 720 | 585 |
| 24 | 610 | 512 | | | | 1,980 | 820 | 662 | 750 | 662 | 855 | 535 |
| 25 | 560 | 512 | | | 490 | 2,090 | 750 | 635 | 690 | 662 | 1,000 | 610 |
| | | | 625 | 635 | | | | | | | | |
| 26 | 610 | 560 | | | | 2,200 | 785 | 535 | 635 | 785 | 820 | 610 |
| 27 | 690 | 585 | | | | 1,980 | 855 | 610 | 662 | 690 | 720 | 610 |
| 28 | 662 | 560 | | | | 1,780 | 820 | 662 | 662 | 470 | 662 | 585 |
| 29 | 720 | 560 | | | ..... | 1,300 | 890 | 635 | 535 | 690 | 785 | 635 |
| 30 | 662 | 490 | | | ..... | 1,210 | 820 | 585 | 470 | 720 | 662 | 662 |
| 31 | 690 | ..... | | | ..... | 1,120 | ..... | 535 | ..... | 720 | 662 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 662 | 890 | 785 | 720 | 750 | 550 | 3,250 | 1,300 | 855 | 2,420 | 560 | 855 |
| 2 | 820 | 750 | 780 | 690 | 820 | 560 | 2,880 | 1,230 | 925 | 1,980 | 690 | 820 |
| 3 | 750 | 635 | 770 | 660 | 890 | 570 | 1,780 | 1,150 | 820 | 1,480 | 750 | 820 |
| 4 | 690 | 720 | 760 | 660 | 840 | 585 | 2,090 | 1,080 | 820 | 1,390 | 750 | 750 |
| 5 | 750 | 785 | 750 | 670 | 780 | 610 | 2,200 | 1,000 | 785 | 1,040 | 750 | 820 |
| 6 | 690 | 750 | 740 | 670 | 760 | 620 | 2,090 | 929 | 890 | 1,040 | 635 | 750 |
| 7 | 690 | 750 | 730 | 670 | 750 | 635 | 1,880 | 855 | 890 | 1,210 | 720 | 820 |
| 8 | 750 | 750 | 720 | 670 | 700 | 660 | 1,780 | 855 | 890 | 1,000 | 855 | 820 |
| 9 | 690 | 855 | 710 | 660 | 650 | 690 | 1,680 | 855 | 1,000 | 1,040 | 720 | 750 |
| 10 | 635 | 1,120 | 700 | 670 | 630 | 785 | 1,580 | 925 | 820 | 960 | 720 | 820 |
| 11 | 610 | 1,680 | 690 | 690 | 600 | 925 | 1,480 | 1,980 | 960 | 960 | 635 | 890 |
| 12 | 635 | 1,780 | 690 | 720 | 580 | 1,040 | 1,580 | 1,680 | 960 | 925 | 750 | 1,040 |
| 13 | 585 | 1,390 | 690 | 750 | 560 | 1,210 | 1,390 | 1,390 | 855 | 890 | 690 | 890 |
| 14 | 635 | 1,390 | 690 | 750 | 560 | 1,680 | 1,210 | 1,120 | 855 | 1,390 | 690 | 750 |
| 15 | 690 | 1,300 | 675 | 750 | 560 | 1,980 | 1,210 | 1,040 | 890 | 1,880 | 690 | 750 |
| 16 | 720 | 1,250 | 660 | 750 | 580 | 2,200 | 1,390 | 960 | 1,780 | 1,980 | 785 | 750 |
| 17 | 610 | 1,210 | 650 | 750 | 610 | 2,310 | 1,300 | 925 | 1,980 | 1,680 | 690 | 690 |
| 18 | 635 | 1,160 | 640 | 825 | 600 | 2,420 | 1,210 | 1,210 | 1,780 | 1,300 | 750 | 750 |
| 19 | 635 | 1,080 | 635 | 875 | 585 | 2,530 | 1,210 | 1,120 | 1,580 | 1,300 | 690 | 855 |
| 20 | 635 | 1,000 | 660 | 925 | 560 | 2,640 | 1,300 | 1,210 | 1,000 | 1,210 | 635 | 1,000 |
| 21 | 720 | 960 | 660 | 940 | 535 | 2,760 | 1,390 | 1,300 | 1,040 | 1,040 | 720 | 960 |
| 22 | 720 | 890 | 660 | 970 | 520 | 2,880 | 1,300 | 1,300 | 890 | 1,000 | 662 | 820 |
| 23 | 662 | 880 | 690 | 1,000 | 510 | 5,310 | 1,980 | 1,580 | 1,040 | 960 | 635 | 820 |
| 24 | 662 | 860 | 720 | 920 | 500 | 5,970 | 1,780 | 1,390 | 960 | 1,000 | 750 | 820 |
| 25 | 690 | 850 | 720 | 875 | 490 | 6,990 | 1,390 | 1,390 | 890 | 925 | 820 | 750 |
| 26 | 662 | 840 | 720 | 855 | 500 | 7,340 | 1,300 | 1,390 | 855 | 820 | 820 | 690 |
| 27 | 690 | 830 | 735 | 830 | 510 | 6,310 | 1,580 | 1,210 | 1,120 | 925 | 820 | 720 |
| 28 | 662 | 820 | 750 | 800 | 520 | 5,160 | 1,580 | 1,040 | 2,200 | 820 | 785 | 820 |
| 29 | 690 | 820 | 780 | 770 | 535 | 4,590 | 1,480 | 1,000 | 3,120 | 890 | 820 | 785 |
| 30 | 750 | 785 | 820 | 750 | ..... | 3,900 | 1,480 | 890 | 3,120 | 720 | 690 | 750 |
| 31 | 820 | ..... | 770 | 750 | ..... | 3,510 | ..... | 750 | ..... | 585 | 820 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 3, 1918, to Mar. 18, 1919, and Nov. 14, 1919, to Mar. 18, 1920; mean discharge during former period and daily discharge during latter period ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Stage-discharge relation affected by growth of aquatic grass May 1 to Sept. 30, 1919; discharge ascertained by means of the indirect method for shifting control. Discharge interpolated July 5, 1919, Mar. 21, 1920, and May 2–6, 1920, on account of lack of gage readings. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Red Cedar River near Colfax, Wis., for the year's ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,100 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 720 | 512 | 582 | 0.529 | 0.61 |
| November | 1,040 | 490 | 644 | .585 | .65 |
| December | ..... | ..... | 547 | .497 | .57 |
| January | ..... | ..... | 645 | .586 | .68 |
| February | ..... | ..... | 488 | .444 | .46 |
| March | 3,380 | ..... | 1,410 | 1.28 | 1.48 |
| April | 2,880 | 750 | 1,360 | 1.24 | 1.38 |
| May | 1,040 | 535 | 762 | .693 | .80 |
| June | 820 | 470 | 647 | .588 | .66 |
| July | 1,390 | 470 | 764 | .695 | .80 |
| August | 1,480 | 662 | 881 | .801 | .92 |
| September | 890 | 535 | 664 | .604 | .67 |
| The year | 3,380 | ..... | 785 | .714 | 9.68 |
| 1919–20. | | | | | |
| October | 820 | 585 | 685 | .623 | .72 |
| November | 1,780 | 635 | 993 | .903 | 1.01 |
| December | 820 | 635 | 714 | .649 | .75 |
| January | 1,000 | 660 | 773 | .703 | .81 |
| February | 890 | 490 | 620 | .564 | .61 |
| March | 7,340 | 550 | 2,580 | 2.35 | 2.71 |
| April | 3,250 | 1,210 | 1,660 | 1.51 | 1.68 |
| May | 1,980 | 750 | 1,160 | 1.05 | 1.21 |
| June | 3,120 | 785 | 1,220 | 1.11 | 1.24 |
| July | 2,420 | 585 | 1,190 | 1.08 | 1.24 |
| August | 855 | 560 | 725 | .659 | .76 |
| September | 1,040 | 690 | 811 | .737 | .82 |
| The year | 7,340 | 490 | 1,100 | 1.00 | 13.56 |

*Days of deficiency in discharge of Red Cedar River near Colfax, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 330 | ..... | ..... | ..... | 0 | ..... | ..... | 0 | 0 |
| 360 | 0 | ..... | ..... | 1 | ..... | ..... | 1 | .05 |
| 390 | 1 | ..... | ..... | 1 | 0 | ..... | 2 | .1 |
| 420 | 2 | ..... | 0 | 1 | 10 | ..... | 13 | .6 |
| 450 | 7 | 0 | 15 | 12 | 12 | ..... | 46 | 2.1 |
| 480 | 21 | 1 | 35 | 35 | 23 | 0 | 115 | 5.3 |
| 510 | 42 | 8 | 56 | 80 | 42 | 5 | 233 | 10.7 |
| 540 | 63 | 8 | 102 | 146 | 74 | 9 | 402 | 18.4 |
| 570 | 88 | 20 | 121 | 156 | 96 | 17 | 498 | 22.8 |
| 600 | 107 | 23 | 148 | 182 | 120 | 25 | 605 | 27.6 |
| 640 | 150 | 68 | 197 | 225 | 180 | 45 | 865 | 39.5 |
| 680 | 191 | 97 | 220 | 238 | 204 | 67 | 1,017 | 46.4 |
| 720 | 191 | 127 | 264 | 278 | 252 | 111 | 1,223 | 56.0 |
| 760 | 224 | 198 | 277 | 296 | 263 | 151 | 1,409 | 64.3 |
| 800 | 254 | 211 | 291 | 312 | 274 | 166 | 1,508 | 68.8 |
| 1,000 | 276 | 264 | 329 | 331 | 312 | 259 | 1,771 | 80.8 |
| 1,400 | 321 | 297 | 347 | 338 | 345 | 312 | 1,960 | 89.5 |
| 2,000 | 355 | 334 | 353 | 357 | 353 | 341 | 2,093 | 95.6 |
| 3,000 | 364 | 353 | 354 | 362 | 362 | 354 | 2,149 | 98.4 |
| 4,000 | 365 | 356 | 363 | 365 | 365 | 359 | 2,173 | 99.2 |
| 5,500 | ..... | 360 | 365 | ..... | ..... | 362 | 2,182 | 99.7 |
| 7,000 | ..... | 366 | ..... | ..... | ..... | 365 | 2,191 | 99.9 |
| 8,500 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 849 | 1,120 | 753 | 711 | 785 | 1,100 | ..... | ..... |
| Maximum (sec.-ft.) | 3,120 | 6,990 | 4,310 | 3,120 | 3,380 | 7,340 | ..... | ..... |
| Minimum (sec.-ft.) | 385 | 470 | 435 | a 440 | a 405 | 490 | ..... | ..... |

a Approximate.

### RED CEDAR RIVER AT CEDAR FALLS, WIS.

LOCATION.—In sec. 6, T. 28 N., R. 12 W., at highway bridge near Cedar Falls, Dunn County, 4½ miles above crossing of Chicago, St. Paul, Minneapolis & Omaha Railway.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1, 1909, to September 30, 1920.

GAGE.—Staff gage fastened to bridge pier; read by John G. Wood.

DISCHARGE MEASUREMENTS.—No discharge measurements have been made at this station, which is maintained to determine fluctuation in stage.

CHANNEL AND CONTROL.—Channel rough and rocky, straight, and free from vegetation. Banks high and not subject to overflow.

EXTREMES OF STAGE.—Maximum stage recorded during year ending September 30, 1919, 5.15 feet at 5 p. m. April 12; minimum stage, 0.75 foot September 21 and 28.

Maximum stage recorded during year ending September 30, 1920, 7.2 feet March 25 and 26; minimum stage, 0.75 foot October 5, 19, 26, November 9, December 7, January 11, 18, February 1, 8, March 7, May 9, August 15, 22, and September 19 and 26.

1909–1920: Maximum stage recorded, 7.2 feet March 25 and 26, 1920; minimum stage, 0.0 foot March 11, 1917. Minimum stages are caused by closing gates and wheels at power plant above station.

REGULATION.—Operation of storage reservoirs in the headwaters of the river (see "Regulation" in station description for Red Cedar River near Colfax, Wis.), together with storage at power plant above gaging station, regulates the flow.

ACCURACY.—No discharge measurements have been made but stage-discharge relation believed permanent. Gage read to half-tenths twice daily during 1919, and once daily during 1920. Considerable diurnal fluctuation is observed, so that mean daily gage height does not represent the average stage.

COOPERATION.—Gage-height record furnished by Wisconsin & Minnesota Light & Power Co.

*Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 2.55 | 2.60 | 1.40 | 2.05 | 3.70 | 2.75 | 3.90 | 3.25 | 1.95 | 3.65 | 3.50 | 1.45 |
| 2 | 2.50 | 2.55 | 2.55 | 2.65 | 1.95 | 1.40 | 3.75 | 3.50 | 3.65 | 3.60 | 3.05 | 3.50 |
| 3 | 2.60 | 1.40 | 2.65 | 2.60 | 3.65 | 2.65 | 3.78 | 2.80 | 3.55 | 3.60 | 1.45 | 3.45 |
| 4 | 2.45 | 2.75 | 2.60 | 2.55 | 2.65 | 3.75 | 3.75 | 2.15 | 3.65 | 1.55 | 2.35 | 3.15 |
| 5 | 2.55 | 2.95 | 2.65 | 1.40 | 2.75 | 2.65 | 3.70 | 3.55 | 3.55 | 2.55 | 3.35 | 3.15 |
| 6 | 1.95 | 2.95 | 2.55 | 2.65 | 2.65 | 2.65 | 3.50 | 3.65 | 3.60 | 2.55 | 3.25 | 2.80 |
| 7 | 2.55 | 2.85 | 3.65 | 2.60 | 2.70 | 2.70 | 3.80 | 3.55 | 3.70 | 3.75 | 3.35 | 1.40 |
| 8 | 2.60 | 2.65 | 1.40 | 3.60 | 2.75 | 2.55 | 3.95 | 3.65 | 1.40 | 3.45 | 3.25 | 3.25 |
| 9 | 2.70 | 3.45 | 3.70 | 2.60 | 1.70 | 2.00 | 4.40 | 3.75 | 3.65 | 3.35 | 2.35 | 3.20 |
| 10 | 2.65 | 1.40 | 3.70 | 3.55 | 2.75 | 2.60 | 4.80 | 3.65 | 3.70 | 3.40 | 2.90 | 3.20 |
| 11 | 2.55 | 2.75 | 2.60 | 3.60 | 2.60 | 2.65 | 4.95 | 3.10 | 3.65 | 3.55 | 3.70 | 3.15 |
| 12 | 2.40 | 3.20 | 3.05 | 1.40 | 2.75 | 3.80 | 5.15 | 3.55 | 3.55 | 3.50 | 3.55 | 3.25 |
| 13 | 1.40 | 3.30 | 3.25 | 3.65 | 2.70 | 3.75 | 5.00 | 3.45 | 3.45 | 1.65 | 3.40 | 2.45 |
| 14 | 2.60 | 3.25 | 3.60 | 3.75 | 2.75 | 3.70 | 4.80 | 3.55 | 3.65 | 3.65 | 3.45 | 1.40 |
| 15 | 2.60 | 3.30 | 1.65 | 3.70 | 3.20 | 3.65 | 4.60 | 3.45 | 2.00 | 3.65 | 3.55 | 3.15 |
| 16 | 2.60 | 3.25 | 3.60 | 3.65 | 1.70 | 4.45 | 4.40 | 3.55 | 3.60 | 3.55 | 3.40 | 2.35 |
| 17 | 2.95 | 1.95 | 3.70 | 3.70 | 2.60 | 4.95 | 4.00 | 3.40 | 3.65 | 3.45 | 1.90 | 2.45 |
| 18 | 2.65 | 2.60 | 3.75 | 3.70 | 2.70 | 4.45 | 3.85 | 2.80 | 3.60 | 3.35 | 3.55 | 2.35 |
| 19 | 2.65 | 2.70 | 3.75 | 1.40 | 2.70 | 4.35 | 3.75 | 3.35 | 3.55 | 3.50 | 3.65 | 2.25 |
| 20 | 1.85 | 3.40 | 3.70 | 2.65 | 2.60 | 4.35 | 2.95 | 3.45 | 3.65 | 1.60 | 3.55 | 2.20 |
| 21 | 2.80 | 3.65 | 3.65 | 2.60 | 2.55 | 4.45 | 3.55 | 3.50 | 3.70 | 3.25 | 3.50 | .75 |
| 22 | 2.95 | 2.75 | 1.40 | 2.70 | 2.70 | 4.35 | 3.65 | 3.42 | 2.00 | 3.35 | 3.50 | 2.15 |
| 23 | 2.55 | 2.65 | 3.70 | 2.75 | 1.70 | 4.20 | 3.75 | 3.50 | 3.70 | 3.40 | 3.50 | 2.20 |
| 24 | 2.65 | 1.95 | 3.60 | 3.65 | 2.75 | 4.05 | 3.68 | 3.45 | 3.65 | 3.30 | 1.40 | 2.15 |
| 25 | 2.55 | 2.65 | 1.60 | 3.80 | 3.55 | 3.95 | 3.65 | 2.00 | 3.60 | 3.20 | 3.45 | 2.25 |
| 26 | 2.60 | 2.60 | 3.10 | 1.40 | 3.65 | 3.95 | 3.55 | 3.45 | 3.55 | 2.75 | 3.40 | 2.30 |
| 27 | 1.60 | 2.65 | 3.10 | 2.75 | 3.75 | 3.90 | 2.00 | 3.35 | 3.65 | 1.60 | 3.35 | 2.15 |
| 28 | 2.90 | 2.65 | 2.65 | 2.70 | 2.65 | 4.15 | 3.35 | 3.40 | 3.55 | 3.55 | 3.45 | .75 |
| 29 | 2.95 | 2.70 | 2.20 | 2.70 | ..... | 4.00 | 3.45 | 3.40 | 1.40 | 3.60 | 3.35 | 2.30 |
| 30 | 2.95 | 2.60 | 3.55 | 2.60 | ..... | 3.90 | 3.55 | 2.75 | 3.55 | 3.45 | 2.95 | 2.20 |
| 31 | 2.65 | ..... | 3.75 | 3.60 | ..... | 4.05 | ..... | 3.55 | ..... | 3.55 | 1.40 | ..... |

*Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 2.20 | 2.20 | 2.10 | 1.08 | .75 | 3.35 | 4.65 | 3.45 | 3.55 | 4.75 | 2.00 | 2.50 |
| 2 | 2.15 | 1.50 | 2.00 | 2.25 | 2.45 | 2.25 | 4.45 | 2.00 | 3.55 | 4.30 | 3.25 | 3.30 |
| 3 | 2.25 | 3.20 | 2.10 | 2.80 | 2.40 | 2.35 | 4.40 | 3.55 | 3.55 | 3.90 | 2.85 | 2.85 |
| 4 | 2.25 | 3.40 | 2.25 | 1.08 | 2.35 | 2.35 | 3.80 | 3.50 | 3.45 | 3.10 | 2.40 | 2.85 |
| 5 | .75 | 3.35 | 2.20 | 3.45 | 2.35 | 2.35 | 3.90 | 3.45 | 3.45 | 3.10 | 2.35 | 2.00 |
| 6 | 3.10 | 3.40 | 2.35 | 2.35 | 2.30 | 2.25 | 3.60 | 3.35 | 2.00 | 3.60 | 2.35 | 2.20 |
| 7 | 2.75 | 3.25 | .75 | 2.30 | 1.85 | .75 | 3.45 | 3.35 | 3.35 | 3.55 | 2.45 | 3.35 |
| 8 | 3.40 | 3.35 | 2.10 | 2.35 | .75 | 2.35 | 3.35 | 3.35 | 3.00 | 3.55 | 2.05 | 3.35 |
| 9 | 2.20 | .75 | 3.35 | 2.30 | 2.75 | 2.25 | 3.30 | .75 | 2.50 | 3.55 | 3.35 | 3.25 |
| 10 | 3.35 | 3.45 | 3.30 | 2.35 | 2.35 | 2.35 | 3.40 | 3.45 | 2.45 | 3.45 | 3.35 | 3.25 |
| 11 | 3.40 | 2.40 | 3.15 | .75 | 2.30 | 2.25 | 1.70 | 3.55 | 3.55 | 2.60 | 3.40 | 2.50 |
| 12 | 1.75 | 2.30 | 3.20 | 3.45 | 2.35 | 2.35 | 3.25 | 3.85 | 3.65 | 3.35 | 3.35 | 1.90 |
| 13 | 2.15 | 3.40 | 3.10 | 3.55 | 2.35 | 2.60 | 3.45 | 4.05 | 1.70 | 3.35 | 3.35 | 3.35 |
| 14 | 2.75 | 3.45 | 1.95 | 3.55 | 2.45 | 1.50 | 3.45 | 4.05 | 3.65 | 3.45 | 2.95 | 3.35 |
| 15 | 2.25 | 3.45 | 3.40 | 2.85 | 1.50 | 3.35 | 3.45 | 4.00 | 3.75 | 3.45 | .75 | 2.50 |
| 16 | 2.20 | 1.45 | 3.35 | 3.45 | 2.30 | 2.35 | 3.35 | 3.00 | 3.80 | 3.55 | 3.35 | 2.90 |
| 17 | 2.15 | 3.50 | 2.80 | 3.35 | 2.25 | 3.40 | 3.45 | 3.80 | 4.30 | 3.55 | 3.30 | 3.35 |
| 18 | 2.75 | 3.50 | 2.15 | .75 | 2.35 | 3.35 | 2.60 | 3.75 | 4.80 | 2.50 | 3.40 | 3.35 |
| 19 | .75 | 3.35 | 2.55 | 2.35 | 2.30 | 3.45 | 3.45 | 3.75 | 4.70 | 3.45 | 3.30 | .75 |
| 20 | 2.20 | 3.40 | 2.00 | 2.30 | 2.25 | 3.55 | 3.40 | 3.65 | 4.00 | 3.45 | 3.20 | 3.45 |
| 21 | 2.10 | 3.45 | 1.18 | 2.35 | 2.35 | 2.05 | 3.35 | 3.65 | 3.80 | 3.35 | 3.25 | 3.35 |
| 22 | 2.05 | 3.35 | 2.55 | 2.35 | 1.45 | 3.65 | 3.38 | 3.75 | 3.75 | 3.30 | .75 | 3.50 |
| 23 | 2.05 | .82 | 2.65 | 2.35 | 2.35 | 3.70 | 3.45 | 3.20 | 3.65 | 3.35 | 3.25 | 3.45 |
| 24 | 1.95 | 3.60 | 2.70 | 2.30 | 2.35 | 6.15 | 3.40 | 3.75 | 3.75 | 3.30 | 3.25 | 3.40 |
| 25 | 1.90 | 3.40 | 1.32 | 1.00 | 2.30 | 7.20 | 2.00 | 3.70 | 3.65 | 2.50 | 3.25 | 3.30 |
| 26 | .75 | 3.35 | 2.75 | 3.35 | 2.75 | 7.20 | 3.55 | 3.60 | 3.75 | 3.35 | 2.85 | .75 |
| 27 | 2.15 | 2.10 | 3.35 | 3.30 | 3.40 | 6.95 | 3.65 | 3.55 | 3.60 | 3.35 | 3.25 | 3.35 |
| 28 | 2.35 | 2.15 | 1.18 | 3.30 | 2.90 | 6.50 | 3.55 | 3.55 | 3.95 | 3.25 | 3.25 | 2.90 |
| 29 | 2.15 | 2.15 | 3.30 | 3.25 | 1.40 | 6.10 | 3.55 | 3.50 | 4.65 | 3.30 | 2.00 | 3.35 |
| 30 | 2.20 | 1.30 | 2.70 | 3.35 | ..... | 5.60 | 3.45 | 1.90 | 4.90 | 2.45 | 3.25 | 3.35 |
| 31 | 2.20 | ..... | 2.25 | 2.35 | ..... | 5.25 | ..... | 2.55 | ..... | 2.40 | 2.45 | ..... |

### RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 21, T. 28 N., R. 13 W., 900 feet below power house of Wisconsin & Minnesota Light & Power Co., Menomonie, Dunn County, and 13 miles above confluence of Red Cedar and Chippewa rivers. Wilson Creek discharges from right into service reservoir just above station.

DRAINAGE AREA.—1,810 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 17, 1907, to September 3, 1908; May 9, 1913, to September 30, 1920.

GAGE.—Barrett & Lawrence water-stage recorder with a wooden well and shelter; installed May 9, 1913, on right bank of river, 1 mile above site of old gage, which was attached to a highway bridge about 200 rods west of Chicago & Northwestern Railway station west of Menomonie; read from June 17, 1907, to September 3, 1908. No relation between datums of the two gages. Gage inspected by E. Kausrud.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1 mile below gage.

CHANNEL AND CONTROL.—Bed at gage composed of heavy gravel; bed at measuring section sandy and subject to shift. Left bank at gage high and not subject to overflow; right bank of medium height and is overflowed at flood stages; both banks high at measuring section and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum discharge during year ending September 30, 1919, estimated 6,000 second-feet March 17 (water-stage recorder not operating satisfactorily); minimum stage, 2.02 feet at noon October 13 (discharge, 444 second-feet).

Maximum discharge during year ending September 30, 1920, estimated 14,000 second-feet March 26 (maximum gage height was about 8.0 feet; water-stage recorder not operating satisfactorily); minimum stage recorded, 1.90 feet at 6 p. m. September 26 and 5 p. m. September 27 (discharge, 330 second-feet).

1907–8 and 1913–1920: Maximum discharge, estimated 14,000 second-feet March 26, 1920 (maximum gage height was about 8.0 feet; water-stage recorder not operating satisfactorily); minimum stage recorded, 0.50 foot November 8, 1907 (discharge, 100 second-feet).

REGULATION.—Considerable diurnal fluctuation in stage at gage is caused by operation of power plants of Wisconsin & Minnesota Light & Power Co. at Menomonie and Cedar Falls. (See "Regulation" in station description for Red Cedar River near Colfax, Wis.).

ICE.—Stage-discharge relation not affected by ice owing to relatively warm water discharged from service reservoir.

ACCURACY.—Stage-discharge relation changed during high water of March, 1919, but has been practically permanent since. Two rating curves used during 1919 and 1920; one, applicable October 1, 1918, to March 20, 1919, well defined between 610 and 1,910 second-feet and between 3,910 and 9,220 second-feet and extended outside these limits; the other, applicable March 21, 1919, to September 30, 1920, well defined between 862 and 9,370 second-feet. Indirect method for shifting control used May 15–20, 1919, with first of the above-mentioned rating curves as basis. Water-stage recorder operated satisfactorily except for brief periods. Daily discharge ascertained by means of discharge integrator except as noted in footnote to tables of daily discharge. Records good except for periods during which gage was not in operation for which they may be subject to error.

*Discharge measurements of Red Cedar River at Menomonie, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| July 4[a] | S. B. Soulé | 2.38 | 862 | Apr. 21 | S. B. Soulé | 3.13 | 1,950 |
| Oct. 24 | do | 2.46 | 923 | June 10 | W. G. Hoyt | [b]2.07 | 597 |
| 1920. | | | | Sept. 28 | S. B. Soulé | 2.83 | 1,490 |
| Mar. 28 | do | 6.00 | 9,370 | | | | |

[a] Rather heavy growth of weeds in channel at measuring section. Water very sluggish in left third of channel. Control apparently normal.

[b] Some uncertainty as to the mean gage height of this measurement on account of the flow having been increased at power plant during latter part of measurement.

*Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 1,080 | 998 | 725 | 826 | 1,090 | 1,120 | 2,420 | 1,120 | 705 | 956 | 1,440 | 731 |
| 2 | 1,190 | 1,070 | 800 | 1,010 | 626 | 552 | 2,080 | 1,140 | 1,460 | 1,120 | 1,250 | 1,050 |
| 3 | 1,150 | 530 | 1,020 | 1,190 | 1,140 | 997 | 1,910 | 1,520 | 1,500 | 1,130 | 768 | 1,040 |
| 4 | 1,540 | 850 | 943 | 961 | 1,130 | 810 | 1,960 | 965 | 1,660 | 967 | 826 | 1,080 |
| 5 | 759 | 890 | 1,050 | 706 | 962 | 907 | 1,940 | 999 | 1,360 | 1,020 | 1,150 | 1,160 |
| 6 | 625 | 1,130 | 965 | 714 | 827 | 1,040 | 1,440 | 2,240 | 1,430 | 910 | 1,700 | 1,080 |
| 7 | 925 | 1,190 | 976 | 748 | 772 | 1,140 | 2,660 | 1,340 | 1,730 | 1,820 | 1,140 | 807 |
| 8 | 925 | 1,160 | 702 | 915 | 868 | 1,160 | 3,030 | 1,800 | 1,100 | 1,320 | 1,180 | 953 |
| 9 | 890 | 1,420 | 932 | 935 | 629 | 850 | 4,460 | 1,450 | 987 | 1,460 | 1,610 | 1,060 |
| 10 | 884 | 1,030 | 1,250 | 1,010 | 692 | 783 | 5,690 | 1,370 | 1,050 | 1,560 | 1,100 | 1,260 |
| 11 | 872 | 780 | 1,280 | 1,100 | 805 | 823 | 5,300 | 1,190 | 1,080 | 1,390 | 1,740 | 1,120 |
| 12 | 849 | 1,280 | 1,040 | 735 | 807 | 1,170 | 5,610 | 1,710 | 1,190 | 1,280 | 1,380 | 1,250 |
| 13 | 504 | 1,360 | 1,130 | 755 | 904 | 1,820 | 5,180 | 2,020 | 1,020 | 975 | 1,510 | 1,180 |
| 14 | 520 | 1,370 | 1,250 | 1,050 | 1,440 | 1,900 | 4,240 | 2,010 | 1,220 | 1,490 | 1,320 | 912 |
| 15 | 801 | 1,290 | 732 | 1,100 | 1,410 | 983 | 2,920 | 2,000 | 890 | 1,780 | 1,530 | 1,060 |
| 16 | 680 | 1,270 | 1,030 | 1,040 | 1,230 | 4,800 | 2,880 | 1,060 | 1,330 | 1,430 | 1,480 | 1,110 |
| 17 | 943 | 875 | 1,120 | 1,040 | 785 | 6,000 | 2,220 | 1,080 | 1,370 | 1,220 | 1,070 | 1,090 |
| 18 | 1,000 | 1,060 | 1,080 | 1,060 | 785 | 5,500 | 2,020 | 1,370 | 1,190 | 1,350 | 1,720 | 1,170 |
| 19 | 1,080 | 1,030 | 1,200 | 680 | 829 | 5,400 | 2,100 | 1,720 | 1,080 | 1,600 | 1,810 | 1,180 |
| 20 | 658 | 1,180 | 1,140 | 699 | 1,220 | 5,300 | 1,680 | 1,180 | 1,430 | 1,060 | 1,440 | 1,180 |
| 21 | 796 | 1,210 | 1,020 | 1,150 | 1,040 | 5,100 | 2,110 | 1,390 | 1,600 | 1,040 | 1,600 | 977 |
| 22 | 1,070 | 1,070 | 800 | 1,130 | 1,080 | 4,900 | 2,180 | 1,320 | 1,030 | 1,410 | 1,640 | 1,140 |
| 23 | 1,120 | 1,090 | 841 | 1,000 | 860 | 3,910 | 2,010 | 1,270 | 1,480 | 1,560 | 1,910 | 1,060 |
| 24 | 1,020 | 878 | 1,400 | 1,080 | 876 | 3,280 | 1,770 | 1,310 | 1,700 | 1,290 | 1,050 | 1,100 |
| 25 | 993 | 652 | 670 | 1,560 | 956 | 2,720 | 1,550 | 1,190 | 1,220 | 1,200 | 1,110 | 1,060 |
| 26 | 1,050 | 714 | 665 | 845 | 1,420 | 2,140 | 1,160 | 1,120 | 1,100 | 1,300 | 1,190 | 1,100 |
| 27 | 658 | 1,170 | 1,040 | 669 | 1,670 | 3,210 | 1,240 | 1,150 | 1,180 | 1,060 | 1,630 | 1,060 |
| 28 | 955 | 625 | 947 | 831 | 1,540 | 3,630 | 1,200 | 1,750 | 1,310 | 1,490 | 1,300 | 726 |
| 29 | 1,360 | 1,060 | 718 | 884 | ..... | 3,510 | 1,630 | 1,660 | 947 | 1,600 | 1,310 | 922 |
| 30 | 1,340 | 1,090 | 1,030 | 846 | ..... | 2,100 | 1,580 | 1,350 | 1,020 | 1,680 | 1,340 | 1,220 |
| 31 | 1,320 | ..... | 1,140 | 1,070 | ..... | 2,320 | ..... | 1,120 | ..... | 1,620 | 806 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 1,230 | 1,000 | 692 | 640 | 624 | 1,010 | 4,690 | 1,610 | 1,640 | 5,520 | 556 | 1,040 |
| 2 | 1,210 | 908 | 901 | 1,050 | 572 | 1,060 | 4,370 | 864 | 1,530 | 3,840 | 926 | 1,120 |
| 3 | 1,170 | 1,030 | 744 | 1,180 | 1,010 | 1,080 | 4,630 | 1,040 | 1,530 | 3,160 | 1,080 | 954 |
| 4 | 1,260 | 1,080 | 755 | 674 | 1,050 | 918 | 4,320 | 1,480 | 1,880 | 1,820 | 909 | 1,200 |
| 5 | 876 | 1,210 | 880 | 1,040 | 954 | 1,120 | 4,020 | 1,150 | 1,480 | 2,110 | 755 | 536 |
| 6 | 1,030 | 1,340 | 875 | 1,180 | 1,050 | 1,150 | 3,710 | 1,460 | 1,010 | 2,280 | 983 | 567 |
| 7 | 1,370 | 1,510 | 593 | 1,210 | 915 | 747 | 3,400 | 1,100 | 1,220 | 1,730 | 876 | 1,220 |
| 8 | 1,410 | 1,540 | 978 | 1,060 | 522 | 838 | 3,090 | 1,320 | 1,190 | 2,150 | 697 | 1,090 |
| 9 | 1,510 | 1,050 | 1,370 | 1,130 | 470 | 1,120 | 2,790 | 491 | 1,010 | 2,290 | 1,140 | 1,160 |
| 10 | 1,440 | 929 | 1,270 | 1,060 | 1,200 | 1,090 | 2,480 | 1,410 | 718 | 2,290 | 1,260 | 891 |
| 11 | 1,200 | 1,150 | 1,340 | 507 | 1,110 | 1,130 | 1,530 | 1,980 | 1,080 | 2,260 | 1,180 | 1,260 |
| 12 | 566 | 2,090 | 1,300 | 842 | 1,040 | 1,190 | 2,680 | 2,130 | 1,100 | 2,170 | 1,200 | 588 |
| 13 | 1,110 | 2,240 | 1,200 | 1,260 | 1,000 | 1,190 | 2,480 | 2,940 | 825 | 1,560 | 1,070 | 1,050 |
| 14 | 1,170 | 1,650 | 1,210 | 1,360 | 1,080 | 706 | 2,030 | 2,340 | 1,450 | 1,630 | 1,070 | 1,060 |
| 15 | 1,090 | 1,670 | 1,280 | 1,360 | 1,190 | 1,110 | 3,930 | 1,740 | 2,020 | 1,680 | 474 | 1,380 |
| 16 | 978 | 1,090 | 1,000 | 1,150 | 1,190 | 1,180 | 2,580 | 841 | 2,420 | 2,220 | 1,130 | 1,600 |
| 17 | 1,020 | 1,200 | 895 | 1,310 | 1,040 | 1,450 | 2,310 | 2,090 | 2,950 | 2,370 | 1,060 | 1,020 |
| 18 | 846 | 1,790 | 842 | 650 | 873 | 1,550 | 1,710 | 1,440 | 3,240 | 2,040 | 1,440 | 887 |
| 19 | 546 | 1,640 | 845 | 860 | 900 | 1,720 | 1,550 | 1,740 | 3,490 | 2,050 | 1,300 | 914 |
| 20 | 917 | 1,590 | 787 | 1,020 | 848 | 1,810 | 2,450 | 1,540 | 2,080 | 2,270 | 1,320 | 931 |
| 21 | 776 | 1,560 | 532 | 1,040 | 1,080 | 1,450 | 2,080 | 1,550 | 2,240 | 2,320 | 1,350 | 1,040 |
| 22 | 928 | 1,440 | 910 | 932 | 1,130 | 3,100 | 1,670 | 1,790 | 1,560 | 2,250 | 1,130 | 1,130 |
| 23 | 1,060 | 685 | 1,010 | 817 | 1,010 | 3,760 | 1,830 | 2,700 | 2,170 | 2,240 | 1,340 | 1,210 |
| 24 | 866 | 1,300 | 945 | 985 | 1,120 | 7,400 | 2,120 | 2,290 | 1,670 | 1,550 | 1,380 | 1,130 |
| 25 | 648 | 1,840 | 578 | 540 | 1,120 | 11,000 | 1,660 | 2,350 | 1,370 | 885 | 972 | 1,010 |
| 26 | 547 | 1,380 | 1,150 | 715 | 1,220 | 14,000 | 2,520 | 1,940 | 1,390 | 1,600 | 999 | 383 |
| 27 | 600 | 983 | 1,300 | 1,160 | 1,280 | 12,000 | 2,150 | 1,760 | 1,010 | 1,530 | 985 | 1,000 |
| 28 | 677 | 1,090 | 528 | 1,120 | 1,290 | 9,400 | 1,600 | 1,570 | 2,480 | 1,430 | 898 | 1,000 |
| 29 | 888 | 848 | 1,130 | 1,060 | 706 | 7,880 | 1,900 | 1,450 | 4,570 | 1,160 | 715 | 1,240 |
| 30 | 1,140 | 513 | 1,230 | 1,100 | ..... | 6,980 | 1,890 | 790 | 5,880 | 732 | 1,040 | 1,120 |
| 31 | 990 | ..... | 920 | 1,150 | ..... | 5,540 | ..... | 1,050 | ..... | 514 | 912 | ..... |

NOTE.—Water-stage recorder records incomplete Mar. 16–22, 1919, and Mar. 24–28, 1920; discharge estimated. Records also incomplete May 14, 1919, and Apr. 4–9, 1920; discharge interpolated.

*Monthly discharge of Red Cedar River at Menomonie, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,810 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,540 | 504 | 953 | 0.527 | 0.61 |
| November | 1,420 | 530 | 1,040 | .575 | .64 |
| December | 1,400 | 665 | 988 | .546 | .63 |
| January | 1,560 | 669 | 946 | .523 | .60 |
| February | 1,670 | 626 | 1,010 | .558 | .58 |
| March | 6,000 | 552 | 2,580 | 1.43 | 1.65 |
| April | 5,690 | 1,160 | 2,610 | 1.44 | 1.61 |
| May | 2,240 | 965 | 1,420 | .785 | .90 |
| June | 1,730 | 705 | 1,270 | .702 | .78 |
| July | 1,820 | 910 | 1,330 | .735 | .85 |
| August | 1,910 | 768 | 1,360 | .751 | .87 |
| September | 1,260 | 726 | 1,060 | .586 | .65 |
| The year | 6,000 | 504 | 1,380 | .762 | 10.37 |
| 1919–20. | | | | | |
| October | 1,510 | 546 | 1,000 | .552 | .64 |
| November | 2,240 | 513 | 1,310 | .724 | .81 |
| December | 1,370 | 528 | 967 | .534 | .62 |
| January | 1,360 | 507 | 1,010 | .558 | .64 |
| February | 1,290 | 470 | 986 | .545 | .59 |
| March | 14,000 | 706 | 3,410 | 1.88 | 2.17 |
| April | 4,690 | 1,530 | 2,670 | 1.48 | 1.65 |
| May | 2,940 | 491 | 1,610 | .890 | 1.03 |
| June | 5,880 | 718 | 1,940 | 1.07 | 1.19 |
| July | 5,520 | 514 | 2,050 | 1.13 | 1.30 |
| August | 1,440 | 474 | 1,040 | .575 | .66 |
| September | 1,600 | 383 | 1,020 | .564 | .63 |
| The year | 14,000 | 383 | 1,590 | .878 | 11.93 |

*Days of deficiency in discharge of Red Cedar River at Menomonie, Wis., for the years ending Sept. 30, 1914–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | | Oct. 1, 1913, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|---|
| | 1913–14 | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1818–19 | 1919–20 | Total days. | Per cent of time. |
| 250 | ..... | ..... | 0 | ..... | ..... | ..... | ..... | 0 | 0.0 |
| 300 | ..... | ..... | 1 | ..... | ..... | ..... | ..... | 1 | .0 |
| 350 | 0 | 0 | 2 | ..... | ..... | ..... | 0 | 2 | .1 |
| 400 | 1 | 1 | 2 | ..... | 0 | ..... | 1 | 5 | .2 |
| 460 | 2 | 1 | 2 | 0 | 6 | 0 | 1 | 12 | .5 |
| 530 | 4 | 3 | 2 | 2 | 24 | 4 | 9 | 48 | 1.9 |
| 610 | 13 | 8 | 5 | 5 | 43 | 13 | 22 | 109 | 4.3 |
| 700 | 29 | 22 | 6 | 23 | 72 | 30 | 31 | 213 | 8.3 |
| 800 | 49 | 44 | 16 | 62 | 111 | 61 | 44 | 387 | 15.1 |
| 920 | 105 | 97 | 46 | 120 | 171 | 86 | 77 | 702 | 27.5 |
| 1,060 | 159 | 161 | 98 | 197 | 253 | 130 | 128 | 1,126 | 44.0 |
| 1,200 | 215 | 205 | 187 | 253 | 310 | 244 | 191 | 1,605 | 62.8 |
| 1,400 | 260 | 261 | 259 | 308 | 330 | 296 | 236 | 1,950 | 76.3 |
| 1,700 | 294 | 297 | 287 | 331 | 339 | 334 | 280 | 2,162 | 84.6 |
| 2,200 | 342 | 327 | 319 | 346 | 349 | 345 | 312 | 2,340 | 91.5 |
| 3,000 | 355 | 349 | 347 | 351 | 355 | 351 | 340 | 2,448 | 95.7 |
| 4,500 | 359 | 360 | 353 | 357 | 361 | 355 | 353 | 2,498 | 97.7 |
| 6,000 | 364 | 365 | 358 | 361 | 364 | 362 | 359 | 2,533 | 99.1 |
| 8,000 | 365 | ..... | 360 | 365 | 365 | 365 | 362 | 2,547 | 99.6 |
| 10,000 | ..... | ..... | 361 | ..... | ..... | ..... | 363 | 2,549 | 99.7 |
| 12,000 | ..... | ..... | 366 | ..... | ..... | ..... | 364 | 2,555 | 99.9 |
| 14,000 | ..... | ..... | ..... | ..... | ..... | ..... | 365 | 2,556 | 100.0 |
| 16,000 | ..... | ..... | ..... | ..... | ..... | ..... | 366 | 2,557 | 100.0 |
| Mean discharge (sec.-ft.) | 1,320 | 1,360 | 1,590 | 1,240 | 1,060 | 1,380 | 1,590 | ..... | ..... |
| Maximum (sec.-ft.) | 6,700 | 5,600 | 11,800 | 7,640 | 6,970 | 6,000 | 14,000 | ..... | ..... |
| Minimum (sec.-ft.) | 354 | 398 | 298 | 480 | 425 | 504 | 383 | ..... | ..... |

### TREMPEALEAU RIVER AT DODGE, WIS.

LOCATION.—In sec. 11, T. 19 N., R. 10 W., at highway bridge in Dodge, Trempealeau County, 9 miles above mouth of river.

DRAINAGE AREA.—633 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 13, 1913, to September 30, 1919, when station was discontinued.

GAGE.—Chain gage attached to downstream side of bridge; read by F. E. Shappee.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; likely to shift. Banks of medium height and may be overflowed during extreme floods.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, estimated about 10,000 second-feet March 17 (high water prevented reading gage); minimum discharge, estimated 120 second-feet February 10 (stage-discharge relation affected by ice).

1914–1919: Maximum stage recorded, 8.35 feet June 9, 1914 (discharge, 3,360 second-feet); on March 17, 1919, the stage rose considerably above 9.5 feet (estimated discharge, 10,000 second-feet); minimum discharge, estimated 105 second-feet February 4 and 5, 1918 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No power plants above station have sufficient capacity to affect natural flow of river.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice. Shifting-channel method used during open-water periods throughout the year; basic rating curve, well defined between 240 and 1,650 second-feet. Gage read to hundredths twice daily except during winter, when it was read irregularly three or four times a week. Daily discharge ascertained by indirect method for shifting control except as indicated in footnote to table of daily discharge. Records poor.

*Discharge measurements of Trempealeau River at Dodge, Wis., during the period Oct. 1, 1918, to Oct 12, 1919.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Nov. 14 | S. B. Soulé | 1.54 | 235 | Apr. 29 | S. B. Soulé | 3.52 | 327 |
| Jan. 24[a] | R. S. Huffman | 2.45 | 269 | June 20 | do | 4.08 | 532 |
| Feb. 24[b] | do | 2.53 | 212 | Oct. 12 | do | 2.38 | 236 |
| Apr. 15 | S. B. Soulé | 4.16 | 455 | | | | |

[a] Complete ice cover at control and measuring section.
[b] Made from bridge and ice; incomplete ice cover at control.

*Daily discharge, in second-feet, of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 224 | 191 | 136 | 170 | 170 | 170 | 408 | 358 | 213 | 213 | 358 | 181 |
| 2 | 202 | 181 | 136 | 155 | 155 | 160 | 433 | 358 | 260 | 213 | 284 | 181 |
| 3 | 191 | 171 | 136 | 155 | 170 | 155 | 433 | 333 | 296 | 213 | 272 | 181 |
| 4 | 181 | 162 | 296 | 155 | 190 | 170 | 459 | 308 | 272 | 248 | 358 | 191 |
| 5 | 171 | 213 | 358 | 155 | 195 | 180 | 408 | 308 | 308 | 284 | 669 | 191 |
| 6 | 176 | 236 | 358 | 155 | 200 | 175 | 383 | 408 | 308 | 260 | 642 | 181 |
| 7 | 181 | 213 | 453 | 155 | 180 | 170 | 511 | 408 | 308 | 248 | 537 | 181 |
| 8 | 181 | 202 | 333 | 155 | 160 | 175 | 642 | 383 | 296 | 213 | 296 | 171 |
| 9 | 191 | 191 | 333 | 155 | 140 | 195 | 669 | 358 | 284 | 202 | 260 | 236 |
| 10 | 202 | 181 | 358 | 155 | 120 | 215 | 669 | 308 | 308 | 191 | 224 | 408 |
| 11 | 213 | 191 | 296 | 165 | 135 | 410 | 695 | 284 | 383 | 191 | 202 | 383 |
| 12 | 224 | 202 | 272 | 170 | 145 | 695 | 616 | 272 | 408 | 191 | 191 | 284 |
| 13 | 224 | 213 | 272 | 180 | 155 | 955 | 511 | 272 | 383 | 181 | 213 | 260 |
| 14 | 224 | 224 | 296 | 190 | 335 | 1,310 | 459 | 260 | 333 | 260 | 202 | 248 |
| 15 | 213 | 260 | 284 | 200 | 390 | 1,950 | 433 | 260 | 296 | 260 | 191 | 213 |
| 16 | 202 | 248 | 260 | 215 | 460 | 5,600 | 459 | 272 | 695 | 236 | 202 | 202 |
| 17 | 202 | 236 | 191 | 220 | 365 | 10,000 | 564 | 284 | 825 | 224 | 202 | 213 |
| 18 | 191 | 236 | 260 | 230 | 270 | 3,530 | 642 | 284 | 773 | 202 | 213 | 213 |
| 19 | 181 | 213 | 195 | 235 | 265 | 2,180 | 642 | 296 | 459 | 181 | 213 | 358 |
| 20 | 176 | 202 | 272 | 240 | 260 | 1,430 | 590 | 284 | 590 | 171 | 236 | 202 |
| 21 | 171 | 181 | 284 | 250 | 235 | 1,450 | 511 | 272 | 358 | 213 | 308 | 224 |
| 22 | 181 | 181 | 224 | 260 | 240 | 825 | 459 | 248 | 308 | 191 | 459 | 236 |
| 23 | 202 | 171 | 235 | 265 | 250 | 747 | 459 | 284 | 272 | 181 | 358 | 224 |
| 24 | 236 | | 235 | 270 | 215 | 669 | 408 | 284 | 260 | 171 | 213 | 224 |
| 25 | 260 | | 235 | 265 | 200 | 616 | 358 | 272 | 260 | 181 | 213 | 191 |
| 26 | 272 | 150 | 225 | 260 | 160 | 616 | 333 | 248 | 236 | 181 | 224 | 181 |
| 27 | 272 | | 215 | 250 | 145 | 590 | 308 | 248 | 224 | 162 | 202 | 181 |
| 28 | 260 | | 190 | 235 | 190 | 511 | 308 | 236 | 213 | 162 | 191 | 181 |
| 29 | 248 | | 190 | 210 | ..... | 485 | 308 | 224 | 191 | 181 | 191 | 181 |
| 30 | 213 | | 190 | 200 | ..... | 459 | 408 | 224 | 181 | 153 | 191 | 191 |
| 31 | 213 | ..... | 190 | 190 | ..... | 433 | ..... | 213 | ..... | 358 | 191 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 23 to Mar. 15; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Gage not read Oct. 6, 13, 20, and Mar. 23; discharge interpolated. Gage not read Nov. 24–30 and Mar. 17; discharge estimated Braced figure shows mean discharge for period indicated.

*Monthly discharge of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1919.*

[Drainage area, 633 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| October | 272 | 171 | 209 | 0.330 | 0.38 |
| November | ..... | ..... | 192 | .303 | .34 |
| December | 433 | 136 | 254 | .401 | .46 |
| January | 270 | 155 | 202 | .319 | .37 |
| February | 460 | 120 | 218 | .344 | .36 |
| March | 10,000 | 155 | 1,200 | 1.90 | 2.19 |
| April | 695 | 308 | 483 | .763 | .85 |
| May | 408 | 213 | 292 | .461 | .53 |
| June | 825 | 181 | 350 | .553 | .62 |
| July | 358 | 153 | 210 | .332 | .38 |
| August | 669 | 191 | 281 | .444 | .51 |
| September | 408 | 171 | 223 | .352 | .39 |
| The year | 10,000 | ..... | 344 | .543 | 7.38 |

*Days of deficiency in discharge of Trempealeau River at Dodge, Wis., for the years ending Sept. 30, 1915–1919.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | Oct. 1, 1914, to Sept. 30, 1919. | |
|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | Total days. | Per cent of time. |
| 120 | ..... | ..... | 3 | 12 | 1 | 16 | 0.9 |
| 140 | ..... | ..... | 13 | 28 | 6 | 47 | 2.6 |
| 160 | ..... | ..... | 33 | 46 | 31 | 110 | 6.0 |
| 180 | ..... | ..... | 56 | 69 | 56 | 181 | 9.9 |
| 200 | 12 | 8 | 82 | 83 | 118 | 303 | 16.6 |
| 220 | 24 | 27 | 116 | 124 | 164 | 455 | 24.9 |
| 240 | 79 | 42 | 141 | 156 | 200 | 618 | 33.8 |
| 260 | 121 | 64 | 167 | 197 | 229 | 778 | 42.6 |
| 280 | 144 | 86 | 179 | 222 | 247 | 878 | 48.1 |
| 300 | 158 | 121 | 202 | 249 | 267 | 997 | 54.6 |
| 320 | 180 | 142 | 218 | 268 | 279 | 1,087 | 59.5 |
| 340 | 203 | 162 | 236 | 274 | 285 | 1,160 | 63.5 |
| 360 | 222 | 184 | 253 | 285 | 298 | 1,242 | 68.0 |
| 380 | 222 | 194 | 262 | 287 | 299 | 1,264 | 69.2 |
| 400 | 235 | 202 | 276 | 293 | 305 | 1,311 | 71.8 |
| 450 | 262 | 231 | 292 | 309 | 319 | 1,413 | 77.4 |
| 500 | 291 | 259 | 310 | 313 | 329 | 1,502 | 82.3 |
| 550 | 299 | 271 | 320 | 318 | 334 | 1,542 | 84.4 |
| 600 | 310 | 291 | 332 | 319 | 338 | 1,590 | 87.1 |
| 800 | 341 | 322 | 349 | 336 | 354 | 1,702 | 93.2 |
| 1,000 | 349 | 342 | 353 | 346 | 357 | 1,747 | 95.6 |
| 2,000 | 365 | 364 | 365 | 359 | 361 | 1,814 | 99.3 |
| 3,000 | ..... | 365 | ..... | 364 | 362 | 1,821 | 99.7 |
| 5,000 | ..... | 366 | ..... | 365 | 363 | 1,824 | 99.9 |
| 10,000 | ..... | ..... | ..... | ..... | 365 | 1,826 | 100.0 |
| Mean discharge (sec.-ft.) | 405 | 476 | 354 | 366 | 344 | ..... | ..... |
| Maximum (sec.-ft.) | 1,560 | 3,080 | 1,640 | 3,280 | a 10,000 | ..... | ..... |
| Minimum (sec.-ft.) | a 191 | 191 | 120 | 105 | a 120 | ..... | ..... |

a Approximate.

### BLACK RIVER AT NEILLSVILLE, WIS.

LOCATION.—In sec. 15, T. 24 N., R. 2 W., at lower highway bridge in Neillsville, Clark County. O'Neill Creek enters from left 1 mile above gage, and Cunningham Creek, also from left, about 1½ miles below.

DRAINAGE AREA.—774 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—April 6, 1905, to March 31, 1909; December 11, 1913, to September 30, 1920.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by A. Bissell.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading in vicinity of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids, a few hundred feet below gage. Banks high and rocky; will not be overflowed at gage section.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year ending September 30, 1919, 11.4 feet at 6 a. m. June 24 (discharge, 8,980 second-feet); minimum discharge, estimated 30 second-feet February 7–12 (stage-discharge relation affected by ice).

Maximum stage recorded during year ending September 30, 1920, 15.2 feet at 6 a. m. March 26 (discharge, 18,400 second-feet); minimum stage recorded, 1.90 feet at 7 p. m. August 28 (discharge, about 26 second-feet).

1905–1909 and 1913–1920: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, about 29,400 second-feet); minimum discharge probably somewhat less than 5 second-feet in February, 1918 (stage-discharge relation affected by ice).

It is probable that the maximum discharge during flood of October 6, 1911, exceeded 29,000 second-feet, but no data are available regarding the stage at the gage section.

REGULATION.—Several dams on Black River and its tributaries upstream from Neillsville are used to create a head for developing power. Operation of these plants causes a slight diurnal fluctuation at gage, especially during winter, when the flow is at a minimum.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve used during 1919, fairly well defined between 40 and 14,000 second-feet; curve used during 1920 is a revision of the 1919 curve above 11 feet (discharge, 8,300 second-feet) and is fairly well defined between 40 and 16,000 second-feet. Gage read to hundredths twice daily. Stage-discharge relation affected by ice, November 30, 1918, to March 16, 1919, and November 27, 1919, to March 20, 1920. Daily discharge for these periods ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records fair except for extreme low stages for which they are poor; winter records poor.

*Discharge measurements of Black River at Neillsville, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 6[a] | W. G. Hoyt | 4.95 | 185 | Jan. 23[a] | J. W. Harris | 3.80 | 95.7 |
| Feb. 7[a] | R. S. Huffman | 2.61 | 30 | Feb. 25[a] | do | 3.85 | 93 |
| Mar. 3[a] | do | 3.40 | 34 | Mar. 27 | S. B. Soulé | 13.58 | 14,100 |
| July 7 | S. B. Soulé | 3.12 | 176 | | | | |
| Oct. 27 | do | 4.33 | 588 | | | | |
| Dec. 9[a] | J. W. Harris | 3.42 | 102 | | | | |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 68 | 416 | 145 | 230 | 85 | 35 | 1,290 | 315 | 167 | 278 | 1,570 | 47 |
| 2 | 60 | 354 | 145 | 220 | 80 | 35 | 1,080 | 460 | 315 | 228 | 1,430 | 45 |
| 3 | 64 | 334 | 145 | 210 | 70 | 35 | 950 | 585 | 2,260 | 184 | 890 | 48 |
| 4 | 65 | 315 | 145 | 200 | 55 | 35 | 950 | 535 | 1,570 | 416 | 660 | 48 |
| 5 | 60 | 510 | 145 | 190 | 46 | 35 | 1,220 | 585 | 890 | 162 | 510 | 83 |
| 6 | 63 | 485 | 145 | 185 | 35 | 35 | 1,890 | 770 | 770 | 142 | 438 | 94 |
| 7 | 57 | 395 | 145 | 180 | 30 | 35 | 3,060 | 1,150 | 660 | 144 | 1,890 | 83 |
| 8 | 58 | 510 | 150 | 175 | 30 | 35 | 7,280 | 950 | 535 | 132 | 3,910 | 65 |
| 9 | 71 | 660 | 160 | 170 | 30 | 40 | 6,280 | 830 | 435 | 122 | 2,160 | 68 |
| 10 | 81 | 770 | 170 | 165 | 30 | 60 | 7,110 | 635 | 416 | 54 | 1,010 | 76 |
| 11 | 120 | 635 | 185 | 160 | 30 | 85 | 7,960 | 460 | 438 | 112 | 585 | 60 |
| 12 | 116 | 560 | 200 | 155 | 30 | 115 | 5,640 | 374 | 1,150 | 92 | 395 | 64 |
| 13 | 108 | 416 | 215 | 150 | 50 | 145 | 3,570 | 296 | 1,360 | 83 | 278 | 56 |
| 14 | 130 | 354 | 230 | 145 | 100 | 200 | 2,460 | 238 | 890 | 84 | 231 | 45 |
| 15 | 122 | 334 | 245 | 140 | 120 | 260 | 1,800 | 296 | 585 | 81 | 228 | 42 |
| 16 | 110 | 296 | 260 | 140 | 50 | 5,000 | 1,430 | 184 | 395 | 60 | 204 | 49 |
| 17 | 92 | 278 | 270 | 135 | 85 | 3,680 | 1,360 | 2,260 | 395 | 64 | 173 | 42 |
| 18 | 87 | 278 | 280 | 130 | 120 | 3,460 | 1,500 | 1,720 | 278 | 53 | 144 | 36 |
| 19 | 84 | 374 | 280 | 130 | 120 | 3,260 | 1,150 | 1,220 | 560 | 53 | 130 | 35 |
| 20 | 84 | 416 | 280 | 125 | 145 | 5,960 | 1,150 | 770 | 395 | 44 | 134 | 53 |
| 21 | 70 | 374 | 415 | 120 | 160 | 6,120 | 1,010 | 535 | 296 | 47 | 132 | 50 |
| 22 | 70 | 334 | 950 | 120 | 170 | 4,700 | 890 | 416 | 395 | 44 | 157 | 57 |
| 23 | 73 | 254 | 1,500 | 115 | 145 | 3,790 | 770 | 438 | 315 | 42 | 210 | 50 |
| 24 | 64 | 184 | 1,220 | 115 | 120 | 3,360 | 610 | 890 | 7,960 | 47 | 170 | 53 |
| 25 | 64 | 195 | 950 | 110 | 85 | 2,760 | 610 | 890 | 6,600 | 42 | 132 | 60 |
| 26 | 71 | 139 | 890 | 110 | 70 | 3,060 | 460 | 635 | 5,000 | 46 | 100 | 56 |
| 27 | 97 | 157 | 460 | 105 | 50 | 3,160 | 374 | 485 | 2,960 | 64 | 86 | 64 |
| 28 | 116 | 157 | 375 | 105 | 40 | 2,660 | 374 | 334 | 1,570 | 78 | 296 | 59 |
| 29 | 222 | 157 | 295 | 100 | ..... | 1,980 | 334 | 238 | 950 | 81 | 60 | 64 |
| 30 | 535 | 155 | 280 | 95 | ..... | 1,720 | 296 | 413 | 610 | 83 | 60 | 98 |
| 31 | 485 | ..... | 260 | 90 | ..... | 1,640 | ..... | 173 | ..... | 395 | 59 | ..... |

*Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | | | | |
| 1 | 254 | 3,680 | 170 | 65 | 70 | 90 | 2,860 | 585 | 170 | 2,360 | 35 | 29 |
| 2 | 234 | 2,360 | 160 | 60 | 75 | 90 | 2,860 | 460 | 132 | 1,500 | 34 | 29 |
| 3 | 510 | 1,570 | 160 | 55 | 75 | 90 | 2,560 | 416 | 110 | 1,010 | 34 | 29 |
| 4 | 416 | 1,150 | 145 | 45 | 85 | 90 | 2,260 | 354 | 94 | 820 | 34 | 30 |
| 5 | 334 | 1,010 | 140 | 40 | 85 | 90 | 1,720 | 278 | 73 | 535 | 34 | 31 |
| 6 | 244 | 890 | 130 | 40 | 90 | 90 | 1,430 | 247 | 70 | 354 | 33 | 34 |
| 7 | 192 | 770 | 125 | 45 | 90 | 85 | 1,220 | 222 | 73 | 315 | 35 | 35 |
| 8 | 160 | 710 | 120 | 50 | 95 | 85 | 830 | 198 | 58 | 296 | 40 | 35 |
| 9 | 144 | 685 | 110 | 50 | 95 | 85 | 710 | 187 | 69 | 315 | 38 | 35 |
| 10 | 130 | 5,640 | 100 | 60 | 100 | 85 | 660 | 195 | 71 | 334 | 38 | 47 |
| 11 | 122 | 6,280 | 90 | 60 | 100 | 100 | 710 | 3,260 | 78 | 228 | 36 | 42 |
| 12 | 216 | 5,000 | 90 | 60 | 95 | 145 | 770 | 2,660 | 354 | 165 | 36 | 46 |
| 13 | 142 | 2,760 | 100 | 60 | 95 | 230 | 710 | 1,640 | 890 | 139 | 36 | 41 |
| 14 | 112 | 1,640 | 90 | 65 | 90 | 295 | 635 | 1,080 | 1,010 | 1,080 | 36 | 32 |
| 15 | 104 | 1,080 | 85 | 65 | 90 | 460 | 560 | 710 | 1,720 | 535 | 36 | 30 |
| 16 | 102 | 890 | 85 | 70 | 90 | 710 | 510 | 535 | 8,130 | 244 | 36 | 32 |
| 17 | 90 | 685 | 85 | 70 | 85 | 950 | 460 | 416 | 8,470 | 139 | 50 | 35 |
| 18 | 90 | 585 | 90 | 70 | 80 | 1,220 | 416 | 334 | 5,320 | 97 | 41 | 35 |
| 19 | 70 | 485 | 100 | 70 | 80 | 1,570 | 374 | 438 | 2,960 | 58 | 34 | 35 |
| 20 | 50 | 416 | 110 | 75 | 75 | 1,800 | 374 | 890 | 1,640 | 64 | 29 | 35 |
| 21 | 87 | 460 | 100 | 85 | 75 | 2,160 | 334 | 1,150 | 1,150 | 71 | 28 | 36 |
| 22 | 118 | 416 | 100 | 90 | 80 | 3,160 | 416 | 1,080 | 710 | 47 | 27 | 39 |
| 23 | 125 | 438 | 100 | 90 | 85 | 6,600 | 2,860 | 3,360 | 510 | 53 | 37 | 52 |
| 24 | 125 | 374 | 85 | 100 | 90 | 9,410 | 4,290 | 2,560 | 416 | 50 | 28 | 46 |
| 25 | 296 | 296 | 80 | 100 | 95 | 11,900 | 2,860 | 1,640 | 296 | 37 | 28 | 50 |
| 26 | 635 | 213 | 80 | 100 | 95 | 17,500 | 1,980 | 1,010 | 231 | 43 | 27 | 52 |
| 27 | 635 | 215 | 85 | 85 | 95 | 13,200 | 1,360 | 685 | 198 | 36 | 26 | 43 |
| 28 | 438 | 170 | 75 | 85 | 90 | 9,410 | 1,080 | 460 | 222 | 35 | 26 | 38 |
| 29 | 354 | 170 | 85 | 75 | 90 | 7,280 | 890 | 334 | 1,570 | 38 | 27 | 47 |
| 30 | 610 | 185 | 85 | 70 | ..... | 5,640 | 710 | 244 | 4,030 | 35 | 29 | 40 |
| 31 | 3,460 | ..... | 75 | 70 | ..... | 3,680 | ..... | 204 | ..... | 35 | 29 | ..... |

*Monthly discharge of Black River at Neillsville, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 774 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 535 | 57 | 111 | 0.143 | 0.16 |
| November | 770 | 139 | 360 | .465 | .52 |
| December | 1,500 | 145 | 372 | .481 | .55 |
| January | 230 | 90 | 146 | .189 | .22 |
| February | 170 | 30 | 77.7 | .100 | .10 |
| March | 6,120 | 35 | 1,850 | 2.39 | 2.76 |
| April | 7,960 | 296 | 2,160 | 2.79 | 3.11 |
| May | 2,260 | 173 | 648 | .837 | .96 |
| June | 7,960 | 167 | 1,370 | 1.77 | 1.98 |
| July | 416 | 42 | 115 | .149 | .17 |
| August | 3,910 | 59 | 595 | .769 | .89 |
| September | 98 | 35 | 58.3 | .075 | .08 |
| The year | 7,960 | 30 | 657 | .849 | 11.50 |
| 1919-20. | | | | | |
| October | 3,460 | 50 | 342 | .442 | .51 |
| November | 6,280 | 170 | 1,370 | 1.78 | 1.99 |
| December | 170 | 75 | 104 | .134 | .15 |
| January | 100 | 40 | 68.5 | .089 | .10 |
| February | 100 | 70 | 87.0 | .112 | .12 |
| March | 17,500 | 85 | 3,170 | 4.10 | 4.73 |
| April | 4,290 | 334 | 1,310 | 1.70 | 1.90 |
| May | 3,360 | 187 | 898 | 1.16 | 1.34 |
| June | 8,470 | 58 | 1,360 | 1.76 | 1.96 |
| July | 2,360 | 35 | 357 | .461 | .53 |
| August | 50 | 26 | 33.4 | .043 | .05 |
| September | 52 | 29 | 38.0 | .049 | .05 |
| The year | 17,500 | 26 | 763 | .986 | 13.43 |

*Days of deficiency in discharge of Black River at Neillsville, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 10 | ..... | ..... | ..... | 59 | ..... | ..... | 59 | 2.7 |
| 20 | ..... | ..... | ..... | 59 | ..... | ..... | 59 | 2.7 |
| 35 | 20 | 15 | 60 | 81 | 16 | 27 | 219 | 10.0 |
| 55 | 47 | 47 | 136 | 130 | 45 | 80 | 485 | 22.2 |
| 80 | 81 | 98 | 166 | 157 | 87 | 113 | 702 | 32.1 |
| 110 | 135 | 132 | 207 | 186 | 117 | 182 | 959 | 43.7 |
| 150 | 176 | 156 | 229 | 205 | 161 | 202 | 1,129 | 51.5 |
| 200 | 202 | 188 | 258 | 213 | 191 | 216 | 1,268 | 57.8 |
| 250 | 220 | 205 | 266 | 224 | 206 | 230 | 1,351 | 61.7 |
| 300 | 228 | 211 | 277 | 240 | 226 | 237 | 1,419 | 64.8 |
| 350 | 235 | 219 | 284 | 249 | 234 | 244 | 1,465 | 66.8 |
| 400 | 248 | 223 | 292 | 277 | 250 | 251 | 1,541 | 70.3 |
| 450 | 254 | 226 | 301 | 286 | 260 | 262 | 1,589 | 72.4 |
| 500 | 260 | 231 | 303 | 293 | 269 | 268 | 1,624 | 74.2 |
| 550 | 261 | 233 | 305 | 294 | 275 | 274 | 1,642 | 74.9 |
| 600 | 271 | 239 | 307 | 298 | 281 | 277 | 1,673 | 76.4 |
| 700 | 285 | 251 | 310 | 302 | 290 | 285 | 1,723 | 78.7 |
| 1,000 | 300 | 268 | 315 | 314 | 309 | 303 | 1,809 | 82.6 |
| 1,400 | 324 | 293 | 322 | 328 | 322 | 318 | 1,907 | 87.1 |
| 2,000 | 342 | 317 | 329 | 351 | 336 | 330 | 2,005 | 91.7 |
| 5,000 | 363 | 355 | 359 | 359 | 356 | 352 | 2,144 | 97.9 |
| 10,000 | 365 | 363 | 365 | 365 | 365 | 363 | 2,186 | 99.7 |
| 15,000 | ..... | 366 | ..... | ..... | ..... | 365 | 2,191 | 99.9 |
| 20,000 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 549 | 902 | 519 | 475 | 657 | 763 | ..... | ..... |
| Maximum (sec.-ft.) | 5,640 | 11,000 | 6,940 | 7,620 | 7,960 | 17,500 | ..... | ..... |
| Minimum (sec.-ft.) | [a]36 | 28 | 25 | [a]5 | 30 | 26 | ..... | ..... |

[a] Approximate.

### LA CROSSE RIVER NEAR WEST SALEM, WIS.

LOCATION.—In sec. 32, T. 17 N., R. 6 W., at highway bridge 2 miles west of West Salem, La Crosse County, and 10 miles above mouth of river. Dutch Creek enters from right 6 miles above station.

DRAINAGE AREA.—412 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 22, 1913, to September 30, 1920.

GAGE.—Chain gage fastened to concrete guardrail on upstream side of bridge; read by Henry Schucht.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock and free from vegetation. Right bank high and not subject to overflow; left bank above the gage low, and subject to overflow at flood stages. Control for low stages is a rocky riffle with a fall of about 6 inches; is apparently drowned out at a stage of about 2.2 feet, causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.45 feet at 6 p. m. March 16 (discharge, about 3,620 second-feet); minimum stage, 1.05 feet at 6 p. m. July 20 (discharge, 135 second-feet).

Maximum stage recorded during year ending September 30, 1920, 6.65 feet at 7 a. m. June 17 (discharge, about 2,390 second-feet); minimum discharge, estimated 100 second-feet January 4 (stage-discharge relation affected by ice).

1913–1920: Maximum stage recorded, 8.45 feet at 6 p. m. March 16, 1919 (discharge, about 3,620 second-feet); minimum discharge, estimated 100 second-feet January 4, 1920 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Diurnal fluctuation at gage amounting at low stages to from 0.10 to 0.40 foot, is caused by operation of power plants, especially at Neshonock dam a few miles above station.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 175 and 1,300 second-feet and fairly well defined between 1,300 and 2,200 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods, December 24, 1918, to January 25, 1919, February 1–10, February 27 to March 13, 1919, and December 1, 1919, to March 23, 1920. during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good except for low stages, for which they are fair; winter records fair.

*Discharge measurements of La Crosse River near West Salem, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 25[a] | R. S. Huffman | 1.98 | 257 | Jan. 24[b] | J. W. Harris | 2.82 | 212 |
| June 19 | S. B. Soulé | 1.81 | 306 | Feb. 26[b] | do | 2.7 | 231 |
| 20 | do | 1.71 | 331 | May 27 | W. G. Hoyt | 1.86 | [c]388 |
| Dec. 20[b] | J. W. Harris | 2.42 | 217 | Sept. 23 | S. B. Soulé | 1.49 | 242 |

[a] Small amount of ice on control section.
[b] Complete ice cover at control and measuring section.
[c] Mean of results of two measurements.

*Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 244 | 308 | 248 | | | 640 | 308 | 237 | 196 | 206 | 288 | 196 |
| 2 | 241 | 288 | 328 | | | 595 | 308 | 223 | 308 | 226 | 268 | 206 |
| 3 | 244 | 248 | 308 | | | 530 | 308 | 288 | 371 | 209 | 230 | 206 |
| 4 | 244 | 328 | 288 | | | 485 | 328 | 268 | 350 | 184 | 226 | 206 |
| 5 | 241 | 328 | 268 | | | 440 | 308 | 328 | 371 | 209 | 248 | 187 |
| 6 | 212 | 328 | 288 | | 260 | 415 | 248 | 328 | 350 | 187 | 394 | 193 |
| 7 | 248 | 308 | 288 | | | 395 | 350 | 416 | 350 | 219 | 328 | 173 |
| 8 | 241 | 288 | 248 | | | 370 | 416 | 506 | 308 | 248 | 288 | 196 |
| 9 | 241 | 288 | 288 | | | 370 | 528 | 416 | 350 | 248 | 268 | 212 |
| 10 | 248 | 230 | 328 | | | 370 | 528 | 328 | 461 | 216 | 181 | 219 |
| 11 | 248 | 288 | 350 | | 288 | 505 | 551 | 288 | 551 | 212 | 230 | 234 |
| 12 | 248 | 288 | 371 | | 241 | 750 | 528 | 268 | 528 | 206 | 200 | 230 |
| 13 | 200 | 268 | 371 | 250 | 288 | 890 | 394 | 268 | 394 | 170 | 206 | 244 |
| 14 | 248 | 248 | 371 | | 416 | 972 | 416 | 268 | 308 | 234 | 209 | 193 |
| 15 | 241 | 288 | 328 | | 438 | 1,090 | 416 | 288 | 288 | 288 | 248 | 244 |
| 16 | 248 | 288 | 371 | | 371 | 2,360 | 416 | 248 | 328 | 288 | 268 | 226 |
| 17 | 241 | 248 | 328 | | 328 | 2,480 | 506 | 268 | 461 | 248 | 288 | 219 |
| 18 | 244 | 308 | 328 | | 328 | 1,190 | 528 | 248 | 394 | 230 | 328 | 206 |
| 19 | 226 | 308 | 288 | | 288 | 835 | 528 | 268 | 350 | 216 | 288 | 200 |
| 20 | 184 | 288 | 308 | | 234 | 528 | 416 | 268 | 308 | 164 | 248 | 209 |
| 21 | 268 | 288 | 328 | | 288 | 506 | 394 | 268 | 308 | 219 | 248 | 212 |
| 22 | 234 | 288 | 288 | | 268 | 438 | 394 | 237 | 248 | 206 | 308 | 241 |
| 23 | 234 | 268 | 328 | | 234 | 371 | 350 | 288 | 288 | 206 | 248 | 234 |
| 24 | 268 | 248 | 330 | | 248 | 416 | 394 | 288 | 248 | 196 | 162 | 241 |
| 25 | 268 | 288 | 330 | | 248 | 394 | 328 | 268 | 241 | 193 | 219 | 216 |
| 26 | 288 | 328 | 310 | 288 | 288 | 394 | 288 | 268 | 244 | 196 | 230 | 212 |
| 27 | 241 | 288 | 290 | 328 | 330 | 371 | 288 | 268 | 234 | 170 | 216 | 193 |
| 28 | 371 | 248 | 290 | 328 | 680 | 350 | 268 | 268 | 226 | 212 | 193 | 177 |
| 29 | 416 | 248 | 290 | 371 | ..... | 350 | 371 | 230 | 187 | 187 | 187 | 248 |
| 30 | 350 | 394 | 290 | 308 | ..... | 268 | 288 | 241 | 212 | 196 | 206 | 288 |
| 31 | 328 | ..... | 290 | 308 | ..... | 308 | ..... | 237 | ..... | 226 | 168 | ..... |

*Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 248 | 715 | 210 | 120 | 145 | 195 | 506 | 328 | 219 | 779 | 190 | 230 |
| 2 | 248 | 573 | 250 | 120 | 155 | 195 | 595 | 268 | 268 | 715 | 245 | 208 |
| 3 | 234 | 416 | 310 | 115 | 165 | 195 | 749 | 288 | 268 | 528 | 248 | 174 |
| 4 | 241 | 371 | 350 | 100 | 150 | 195 | 638 | 308 | 268 | 394 | 230 | 176 |
| 5 | 244 | 350 | 310 | 130 | 155 | 195 | 551 | 288 | 268 | 394 | 240 | 190 |
| 6 | 288 | 328 | 235 | 150 | 150 | 195 | 484 | 288 | 199 | 416 | 237 | 202 |
| 7 | 268 | 328 | 195 | 135 | 170 | 195 | 416 | 288 | 248 | 573 | 230 | 230 |
| 8 | 248 | 288 | 180 | 160 | 155 | 195 | 394 | 268 | 288 | 616 | 216 | 237 |
| 9 | 230 | 288 | 180 | 150 | 175 | 195 | 384 | 222 | 328 | 528 | 268 | 230 |
| 10 | 230 | 461 | 175 | 170 | 180 | 195 | 394 | 308 | 308 | 506 | 268 | 208 |
| 11 | 234 | 715 | 175 | 170 | 170 | 250 | 350 | 328 | 288 | 394 | 230 | 248 |
| 12 | 209 | 779 | 175 | 230 | 150 | 270 | 394 | 371 | 328 | 371 | 245 | 176 |
| 13 | 230 | 506 | 175 | 205 | 125 | 290 | 371 | 438 | 230 | 308 | 237 | 244 |
| 14 | 248 | 416 | 175 | 220 | 135 | 330 | 371 | 371 | 416 | 308 | 237 | 223 |
| 15 | 226 | 461 | 175 | 145 | 130 | 350 | 350 | 328 | 1,230 | 308 | 230 | 215 |
| 16 | 226 | 308 | 175 | 175 | 150 | 395 | 350 | 268 | 2,120 | 288 | 248 | 222 |
| 17 | 219 | 371 | 175 | 160 | 120 | 415 | 328 | 328 | 2,300 | 308 | 240 | 222 |
| 18 | 226 | 328 | 175 | 155 | 105 | 460 | 288 | 308 | 1,550 | 216 | 215 | 230 |
| 19 | 206 | 328 | 175 | 165 | 115 | 505 | 308 | 288 | 1,060 | 328 | 208 | 176 |
| 20 | 268 | 328 | 175 | 165 | 135 | 550 | 371 | 288 | 779 | 288 | 208 | 202 |
| 21 | 248 | 328 | 115 | 155 | 135 | 595 | 461 | 248 | 749 | 288 | 215 | 244 |
| 22 | 244 | 288 | 150 | 145 | 135 | 715 | 461 | 328 | 749 | 288 | 184 | 230 |
| 23 | 226 | 241 | 150 | 135 | 160 | 715 | 416 | 371 | 749 | 268 | 222 | 219 |
| 24 | 193 | 288 | 170 | 140 | 145 | 678 | 416 | 616 | 616 | 268 | 239 | 226 |
| 25 | 241 | 328 | 140 | 130 | 140 | 678 | 328 | 678 | 506 | 223 | 208 | 212 |
| 26 | 226 | 288 | 165 | 160 | 180 | 779 | 371 | 506 | 461 | 241 | 215 | 160 |
| 27 | 268 | 268 | 170 | 145 | 195 | 862 | 371 | 394 | 371 | 248 | 223 | 193 |
| 28 | 268 | 288 | 150 | 150 | 195 | 807 | 371 | 328 | 438 | 244 | 240 | 181 |
| 29 | 288 | 219 | 135 | 150 | 195 | 678 | 350 | 308 | 779 | 216 | 187 | 187 |
| 30 | 328 | 196 | 170 | 150 | ..... | 595 | 328 | 219 | 1,190 | 238 | 223 | 193 |
| 31 | 394 | ..... | 160 | 140 | ..... | 551 | ..... | 288 | ..... | 241 | 230 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge of La Crosse River near West Salem, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 412 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 416 | 184 | 258 | 0.626 | 0.72 |
| November | 394 | 230 | 288 | .699 | .78 |
| December | 371 | 248 | 312 | .757 | .87 |
| January | ..... | ..... | 264 | .641 | .74 |
| February | 680 | 234 | 300 | .728 | .76 |
| March | 2,480 | 268 | 657 | 1.59 | 1.83 |
| April | 551 | 248 | 390 | .947 | 1.06 |
| May | 506 | 223 | 286 | .694 | .80 |
| June | 551 | 187 | 325 | .789 | .88 |
| July | 288 | 164 | 213 | .517 | .60 |
| August | 394 | 162 | 246 | .597 | .69 |
| September | 288 | 173 | 215 | .522 | .58 |
| The year | 2,480 | ..... | 313 | .760 | 10.31 |
| 1919–20. | | | | | |
| October | 394 | 193 | 248 | .602 | .69 |
| November | 779 | 196 | 380 | .922 | 1.03 |
| December | 350 | 115 | 188 | .456 | .53 |
| January | 230 | 100 | 153 | .371 | .43 |
| February | 195 | 105 | 152 | .369 | .40 |
| March | 862 | 195 | 433 | 1.05 | 1.21 |
| April | 749 | 288 | 416 | 1.01 | 1.13 |
| May | 678 | 219 | 337 | .818 | .94 |
| June | 2,300 | 199 | 652 | 1.58 | 1.76 |
| July | 779 | 216 | 365 | .886 | 1.02 |
| August | 268 | 184 | 228 | .553 | .64 |
| September | 248 | 160 | 210 | .510 | .57 |
| The year | 2,300 | 100 | 313 | .760 | 10.35 |

*Days of deficiency in discharge of La Crosse River near West Salem, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 100 | ..... | ..... | ..... | ..... | ..... | 0 | 0 | 0.0 |
| 110 | ..... | ..... | ..... | ..... | ..... | 2 | 2 | .1 |
| 120 | ..... | ..... | 0 | 0 | ..... | 5 | 5 | .2 |
| 130 | ..... | ..... | 1 | 1 | ..... | 9 | 11 | .5 |
| 140 | ..... | ..... | 1 | 3 | ..... | 19 | 23 | 1.0 |
| 150 | 0 | ..... | 3 | 8 | ..... | 28 | 39 | 1.8 |
| 160 | 21 | 0 | 8 | 13 | 0 | 45 | 87 | 4.0 |
| 170 | 33 | 2 | 17 | 15 | 5 | 55 | 127 | 5.8 |
| 180 | 46 | 4 | 29 | 18 | 7 | 79 | 183 | 8.3 |
| 190 | 46 | 7 | 44 | 22 | 15 | 87 | 221 | 10.1 |
| 200 | 79 | 26 | 62 | 24 | 29 | 108 | 328 | 15.0 |
| 210 | 95 | 34 | 72 | 33 | 43 | 118 | 395 | 18.0 |
| 230 | 125 | 70 | 86 | 58 | 72 | 147 | 558 | 25.5 |
| 250 | 190 | 99 | 136 | 132 | 154 | 197 | 908 | 41.4 |
| 270 | 208 | 119 | 160 | 174 | 191 | 215 | 1,067 | 48.7 |
| 300 | 232 | 181 | 211 | 207 | 238 | 239 | 1,308 | 59.7 |
| 350 | 277 | 267 | 280 | 286 | 297 | 273 | 1,680 | 77.1 |
| 400 | 294 | 298 | 305 | 302 | 323 | 303 | 1,825 | 83.3 |
| 500 | 332 | 328 | 334 | 316 | 340 | 320 | 1,970 | 89.9 |
| 700 | 351 | 345 | 349 | 338 | 357 | 344 | 2,084 | 95.1 |
| 1,000 | 365 | 361 | 357 | 349 | 361 | 360 | 2,153 | 98.2 |
| 1,500 | ..... | 365 | 360 | 360 | 363 | 363 | 2,176 | 99.3 |
| 2,000 | ..... | 366 | 363 | 362 | 363 | 364 | 2,183 | 99.6 |
| 3,000 | ..... | ..... | 365 | 365 | 365 | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 307 | 347 | 336 | 362 | 313 | 313 | ..... | ..... |
| Maximum (sec.-ft.) | 862 | 1,690 | 2,480 | 2,300 | 2,480 | 2,300 | ..... | ..... |
| Minimum (sec.-ft.) | [a] 155 | 170 | 130 | 125 | 162 | 100 | ..... | ..... |

[a] Approximate.

### UPPER IOWA RIVER NEAR DECORAH, IOWA.

LOCATION.—At highway bridge in Freeport, 3 miles below Decorah, Winneshiek County, and 4 miles above upper power plant of Interstate Power Co. Nearest tributary, Trout Run, which enters from right, 1 mile above station.

DRAINAGE AREA.—560 square miles (measured on United States Geological Survey base map; scale, 1:500,000).

RECORDS AVAILABLE.—August 27, 1913, to November 21, 1914, and May 12, 1919, to September 30, 1920.

GAGE.—Gurley water-stage recorder on left bank 500 feet above highway bridge, installed August 28, 1920. Chain gage attached to handrail of highway bridge used prior to that date. Water-stage recorder at datum 3.96 feet higher than datum of chain gage. Observer, Mrs. W. D. Gross.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed at chain gage section composed of sand and gravel; shifting. Gravel bar below highway bridge forms control for chain gage. Rock ledge forms control for water-stage recorder; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period May 12, 1919, to September 30, 1920, 11.05 feet at 5 a. m. September 10, 1919 (discharge, 6,220 second-feet); minimum discharge, 101 second-feet September 17, 1919 (gage height, 2.80 feet).

1913–14 and 1919–20: Maximum stage recorded, 11.6 feet May 24, 1914 (discharge, about 7,100 second-feet); minimum stage, 2.15 feet September 10 and 13–16, 1913 (discharge, 37 second-feet).

ICE.—Stage-discharge relation affected by ice for short periods during extremely cold weather.

REGULATION.—Operation of several mills in Decorah may cause slight diurnal fluctuation at gage.

ACCURACY.—Stage-discharge relation probably permanent during period for both chain gage and water-stage recorder, except as affected by ice. Rating curve for chain gage, applicable May 12, 1919, to August 28, 1920, is well defined between 1,600 and 14,000 second-feet, and fairly well defined between 100 and 1,600 second-feet. Rating curve for water-stage recorder, applicable August 29 to September 30, 1920, is well defined between 100 and 10,000 second-feet. Chain gage read to hundredths twice daily prior to August 28, 1920; mean gage heights from water-stage recorder graph thereafter. Daily discharge ascertained by applying mean daily gage height to rating table except for period, November 28, 1919, to March 11, 1920, during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of observer's notes, weather records, and comparison with flow of Squaw Creek at Ames, Iowa. Open-water records good; winter records fair.

*Discharge measurements of Upper Iowa River near Decorah, Iowa, during the years ending Sept. 30, 1919 and 1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| 1919. | *Feet.* | *Sec.-ft.* |
| May 13 | 3.90 | 433 |
| July 25 | 3.10 | 175 |
| Nov. 19 | 3.75 | 412 |
| 1920. | | |
| Apr. 15 | 3.93 | 497 |
| June 12 | 3.62 | 337 |
| Aug. 25 | [a] 1.96 | 134 |
| 29 | [a] 2.65 | 440 |

[a] Gage height at datum of water-stage recorder; others at datum of chain gage.

*Daily discharge, in second-feet, of Upper Iowa River near Decorah, Iowa, for the period May 12, 1919, to Sept. 30, 1920.*

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | 1919. | | | | | |
| 1 | ..... | 243 | 321 | 226 | 120 | 16 | 384 | 1,380 | 406 | 147 | 105 |
| 2 | ..... | 300 | 280 | 181 | 120 | 17 | 342 | 960 | 342 | 144 | 101 |
| 3 | ..... | 1,010 | 260 | 167 | 124 | 18 | 321 | 760 | 243 | 142 | 124 |
| 4 | ..... | 860 | 243 | 167 | 122 | 19 | 300 | 660 | 226 | 135 | 154 |
| 5 | ..... | 760 | 260 | 167 | 129 | 20 | 300 | 428 | 210 | 144 | 142 |
| 6 | ..... | 760 | 226 | 157 | 122 | 21 | 280 | 300 | 195 | 144 | 710 |
| 7 | ..... | 710 | 210 | 142 | 120 | 22 | 260 | 495 | 195 | 142 | 243 |
| 8 | ..... | 612 | 226 | 152 | 124 | 23 | 280 | 428 | 195 | 142 | 181 |
| 9 | ..... | 495 | 226 | 147 | 210 | 24 | 260 | 428 | 164 | 133 | 167 |
| 10 | ..... | 1,940 | 243 | 142 | 1,810 | 25 | 243 | 760 | 167 | 129 | 147 |
| 11 | ..... | 4,660 | 226 | 147 | 300 | 26 | 210 | 612 | 162 | 133 | 124 |
| 12 | 495 | 2,140 | 195 | 147 | 167 | 27 | 195 | 450 | 154 | 129 | 120 |
| 13 | 472 | 1,620 | 226 | 157 | 144 | 28 | 210 | 406 | 150 | 133 | 142 |
| 14 | 428 | 1,160 | 342 | 147 | 142 | 29 | 195 | 384 | 150 | 131 | 1,810 |
| 15 | 406 | 960 | 260 | 147 | 120 | 30 | 195 | 342 | 152 | 138 | 450 |
| | | | | | | 31 | 195 | ..... | 612 | 122 | ..... |

*Daily discharge, in second-feet, of Upper Iowa River near Decorah, Iowa, for the period May 12, 1919, to Sept. 30, 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 321 | 243 | | | | | 1,110 | 564 | 384 | 342 | 210 | 191 |
| 2 | 300 | 243 | | 200 | | | 1,010 | 564 | 384 | 321 | 210 | 187 |
| 3 | 260 | 300 | | | | | 810 | 564 | 384 | 1,010 | 210 | 183 |
| 4 | 1,220 | 260 | | | | | 710 | 518 | 342 | 342 | 280 | 207 |
| 5 | 428 | 280 | | | 120 | 120 | 710 | 472 | 342 | 518 | 363 | 235 |
| 6 | 342 | 260 | | | | | 710 | 450 | 321 | 612 | 243 | 211 |
| 7 | 300 | 243 | | 160 | | | 564 | 363 | 321 | 406 | 243 | 203 |
| 8 | 300 | 243 | | | | | 564 | 321 | 300 | 384 | 226 | 203 |
| 9 | 280 | 260 | | | | | 518 | 342 | 612 | 472 | 226 | 207 |
| 10 | 260 | 1,810 | | | | 140 | 518 | 428 | 363 | 428 | 210 | 387 |
| 11 | 243 | 1,440 | 220 | | | 230 | 564 | 1,110 | 363 | 428 | 210 | 658 |
| 12 | 243 | 1,010 | | | | 1,440 | 518 | 660 | 321 | 406 | 210 | 273 |
| 13 | 226 | 660 | | | | 960 | 518 | 760 | 300 | 342 | 210 | 215 |
| 14 | 226 | 612 | | | | 810 | 495 | 612 | 300 | 300 | 210 | 195 |
| 15 | 226 | 518 | | | 130 | 3,100 | 472 | 518 | 428 | 300 | 210 | 191 |
| 16 | 226 | 495 | | 130 | | 2,760 | 472 | 495 | 660 | 280 | 210 | 176 |
| 17 | 226 | 472 | | | | 2,220 | 450 | 472 | 518 | 260 | 210 | 164 |
| 18 | 226 | 428 | | | | 1,380 | 406 | 450 | 450 | 260 | 195 | 161 |
| 19 | 226 | 406 | | | | 1,060 | 428 | 518 | 406 | 260 | 195 | 157 |
| 20 | 226 | 363 | | | | 910 | 1,160 | 472 | 472 | 243 | 226 | 172 |
| 21 | 210 | 342 | | | | 910 | 2,300 | 472 | 342 | 260 | 321 | 161 |
| 22 | 195 | 342 | | | | 960 | 1,330 | 910 | 342 | 260 | 243 | 153 |
| 23 | 210 | 321 | | | | 1,060 | 1,060 | 2,220 | 342 | 280 | 226 | 149 |
| 24 | 210 | 300 | | | | 1,110 | 860 | 1,330 | 321 | 260 | 210 | 153 |
| 25 | 210 | 300 | | | 120 | 1,500 | 810 | 1,160 | 300 | 243 | 195 | 168 |
| 26 | 243 | 260 | 200 | 120 | | 4,040 | 760 | 1,060 | 300 | 243 | 181 | 138 |
| 27 | 210 | 210 | | | | 3,280 | 760 | 1,010 | 300 | 226 | 181 | 134 |
| 28 | 210 | 220 | | | | 1,740 | 960 | 910 | 280 | 226 | 142 | 127 |
| 29 | 195 | 220 | | | | 1,380 | 860 | 760 | 1,010 | 226 | 363 | 123 |
| 30 | 760 | 220 | | | ..... | 1,010 | 660 | 660 | 384 | 210 | 260 | 127 |
| 31 | 472 | ..... | | | ..... | 960 | ..... | 450 | ..... | 226 | 199 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge of Upper Iowa River near Decorah, Iowa, for the period May 12, 1919, to Sept. 30, 1920.*

[Drainage area, 560 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1919. | | | | | |
| May 12–31 | ..... | ..... | 299 | 0.534 | 0.40 |
| June | 4,660 | 243 | 908 | 1.62 | 1.81 |
| July | 612 | 150 | 241 | .430 | .50 |
| August | 226 | 122 | 148 | .264 | .30 |
| September | 1,810 | 101 | 286 | .511 | .57 |
| 1919–20. | | | | | |
| October | 1,220 | 195 | 304 | .543 | .63 |
| November | 1,810 | ..... | 443 | .791 | .88 |
| December | ..... | ..... | 214 | .382 | .44 |
| January | ..... | ..... | 141 | .252 | .29 |
| February | ..... | ..... | 124 | .221 | .24 |
| March | 4,040 | ..... | 1,100 | 1.96 | 2.26 |
| April | 2,300 | 406 | 769 | 1.37 | 1.53 |
| May | 2,220 | 321 | 697 | 1.24 | 1.43 |
| June | 1,010 | 280 | 396 | .707 | .79 |
| July | 1,010 | 210 | 341 | .609 | .70 |
| August | 363 | 142 | 227 | .405 | .47 |
| September | 658 | 123 | 200 | .357 | .40 |
| The year | 4,040 | ..... | 414 | .739 | 10.06 |

### WISCONSIN RIVER AT WHIRLPOOL RAPIDS, NEAR RHINELANDER, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 8 E., at head of Whirlpool Rapids, 1 mile below mouth of outlet of Crescent Lake, which comes in from right, and 3 miles downstream from power station of Rhinelander Power Co., and 10 miles southwest of Rhinelander, Lincoln County.

DRAINAGE AREA.—1,160 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—September 15, 1915, to September 30, 1920. December 1, 1905, to September 30, 1915, records were obtained at a station 3 miles upstream.

GAGE.—Stevens continuous water-stage recorder in a wooden shelter on right bank; inspected by C. W. Jewell.

DISCHARGE MEASUREMENTS.—Made from cable about 150 feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Banks medium high and not subject to overflow. Control is head of rapids, 100 feet downstream from gage; well defined and permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.28 feet at 10 p. m. April 13 (discharge, 3,200 second-feet); minimum stage not known.

Maximum stage recorded during year ending September 30, 1920, 5.2 feet at 2 p. m. April 1 (discharge, 4,520 second-feet); minimum stage recorded, 1.4 feet at 6 a. m. September 27 (discharge, 435 second-feet). It is quite probable that the maximum stage occurred during the latter part of March when recording gage was not in operation.

1905–1920: Maximum stage recorded, 5.61 feet April 22, 1916 (discharge, 5,250 second-feet); minimum discharge, practically no flow, at old station, during August and September, 1907, and June and July, 1908; minimum stage at present location, 0.65 foot July 7, 1918 (discharge, 165 second-feet). Discharge at present location of station will probably never be zero. Minimum discharge caused almost entirely by regulation.

REGULATION.—Above the station are 14 reservoirs[6] which are operated by the Wisconsin Valley Improvement Co. for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is 2.8 billion cubic feet during the summer and 3.6 billion cubic feet during the winter. Owing to the operation of these various storage reservoirs and the service reservoirs of three power plants on the river above, the flow at the station is not natural.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 212 and 5,410 second-feet. Operation of water-stage recorder satisfactory except as noted in footnote to tables of daily discharge. Daily discharge ascertained by means of discharge integrator except as indicated in footnote to tables of daily discharge. Open-water records, when water-stage recorder was in operation, excellent; records for other periods, poor.

*Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 21 | S. B. Soulé | 2.51 | 1,160 | May 28 | W. G. Hoyt | 2.62 | 1,280 |
| | | | | Sept. 22 | S. B. Soulé | 2.12 | 832 |
| 1919. | | | | | | | |
| Jan. 12[a] | do | [b]2.11 | 684 | 1920. | | | |
| Feb. 11[a] | do | [b]2.35 | 859 | June 13 | do | 2.19 | 908 |
| Mar. 7[a] | do | [b]2.46 | 992 | | | | |

[a] Measurement made from highway bridge 2 miles above station and just below Hat Rapids power plant.
[b] Reading of U. S. Weather Bureau chain gage at Hat Rapids bridge.

[6] Information concerning these reservoirs, based on maps and data furnished by W. E. Brooks, manager of the Wisconsin Valley Improvement Co., and data collected by the engineering department of the Railroad Commission of Wisconsin, is contained in Water-Supply Paper 405, p. 127.

*Daily discharge, in second-feet, of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | | | | 918 | 910 | 950 | 1,480 | | 770 | 2,040 | 1,180 | 515 |
| 2 | | | | 930 | 910 | 790 | 1,330 | | 651 | 1,800 | 904 | 630 |
| 3 | | | | 1,020 | 990 | 1,030 | 1,380 | | 1,080 | 1,470 | 887 | 690 |
| 4 | | | | | 910 | 1,020 | 1,480 | | 1,130 | 1,240 | 717 | 905 |
| 5 | | | 900 | | 990 | 990 | 1,400 | | 1,150 | 1,440 | 1,230 | 850 |
| 6 | | | | 900 | 910 | 950 | 1,330 | | 1,120 | 1,380 | 1,400 | 850 |
| 7 | | | | | 950 | 950 | 1,480 | | 1,280 | 1,580 | 1,480 | 805 |
| 8 | | | | | 1,030 | 950 | 1,520 | | 929 | 1,480 | 1,280 | 650 |
| 9 | | | | | 910 | 870 | 1,650 | | 1,320 | 1,430 | 1,060 | 770 |
| 10 | | | 970 | 910 | 790 | 950 | 1,740 | | 1,310 | 1,410 | 940 | 870 |
| 11 | | | 970 | 950 | 1,030 | 990 | 1,900 | | 1,390 | 1,360 | 920 | 850 |
| 12 | | | 1,010 | 910 | 950 | 950 | 2,280 | | 1,450 | 1,330 | 1,060 | 835 |
| 13 | | | 958 | 830 | 870 | 910 | 2,530 | | 1,680 | 1,280 | 1,000 | 880 |
| 14 | | | 961 | 1,070 | 910 | 950 | 2,660 | | 1,560 | 1,140 | 960 | 620 |
| 15 | | | 776 | 1,120 | 990 | 1,030 | 2,180 | | 2,050 | 1,310 | 950 | 620 |
| 16 | 900 | 1,100 | 780 | 1,030 | 910 | 790 | 2,320 | 1,200 | 1,880 | 1,250 | 976 | 790 |
| 17 | | | 780 | 990 | 870 | 1,200 | 2,400 | | 1,670 | 1,230 | 815 | 821 |
| 18 | | | 825 | 990 | 990 | 1,120 | 1,920 | | 1,550 | 890 | 800 | 787 |
| 19 | | | 813 | 715 | 990 | 1,120 | 1,910 | | 1,560 | 1,080 | 1,180 | 722 |
| 20 | | | 785 | 990 | 990 | 1,200 | 1,760 | | 1,470 | | 937 | 690 |
| 21 | | | 1,020 | 990 | 1,030 | 1,380 | 1,860 | | 1,340 | | 1,020 | 550 |
| 22 | | | 1,380 | 1,120 | 1,070 | 1,520 | 1,580 | | 970 | 800 | 1,050 | 655 |
| 23 | | | 1,240 | 1,160 | 870 | 1,730 | 1,670 | | 940 | | 1,230 | 885 |
| 24 | | | 1,100 | 990 | 910 | 1,900 | | | 2,060 | | 948 | 765 |
| 25 | | | 1,020 | 1,120 | 990 | 1,900 | | | 2,390 | | 749 | 735 |
| 26 | | | 1,000 | 870 | 990 | 2,240 | 1,500 | | 2,610 | 1,330 | 1,220 | 785 |
| 27 | | | 1,000 | 990 | 990 | 2,060 | | | 2,550 | 1,140 | 1,300 | 690 |
| 28 | | | 1,000 | 870 | 950 | 1,430 | | | 2,630 | 1,280 | 910 | 420 |
| 29 | | | 1,000 | 950 | ..... | 2,040 | | | 2,060 | 1,270 | 930 | 635 |
| 30 | | | 960 | 990 | ..... | 2,200 | | | 2,020 | 1,260 | 923 | 920 |
| 31 | | ..... | 1,050 | 950 | ..... | 1,560 | ..... | | ..... | 1,230 | 762 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 890 | 1,310 | 931 | | | | 4,130 | 1,540 | 928 | | 815 | 926 |
| 2 | 958 | 1,160 | 1,110 | | | | 3,990 | 1,430 | 944 | | 728 | 790 |
| 3 | 970 | 1,140 | 1,160 | | | | 3,790 | 943 | 896 | | 750 | 916 |
| 4 | 953 | 1,600 | | | | | | 1,050 | 826 | | 773 | 920 |
| 5 | 775 | 1,760 | | | | 924 | | 1,400 | 762 | | 786 | 782 |
| 6 | 724 | 1,440 | | | | | 2,240 | 1,380 | 583 | | 842 | 502 |
| 7 | 1,020 | 1,450 | | | | | | 1,290 | 671 | | 1,150 | 639 |
| 8 | 1,010 | 1,430 | | | | | | 972 | 1,070 | | 724 | 862 |
| 9 | 984 | 1,560 | | | | | | 900 | 902 | | 836 | 849 |
| 10 | 971 | 1,370 | | | | | | 819 | 900 | | 1,130 | 877 |
| 11 | 800 | 1,760 | | | | | 1,800 | 738 | 1,150 | | 1,140 | 876 |
| 12 | 750 | 1,870 | | | | | 1,860 | 776 | 1,210 | | 1,140 | 680 |
| 13 | 1,080 | 2,140 | | | | | 1,550 | 812 | 994 | | 1,090 | 794 |
| 14 | 1,290 | 1,850 | | | | | 1,560 | 723 | 1,160 | 1,120 | 1,150 | 956 |
| 15 | 950 | 1,800 | | | 965 | | 1,520 | 1,120 | 1,530 | | 802 | 796 |
| 16 | 832 | 1,600 | | 965 | | | 1,460 | 1,060 | 1,610 | | 1,030 | 858 |
| 17 | 866 | 1,260 | 906 | | | 1,190 | 1,440 | 870 | 1,950 | | 1,090 | 882 |
| 18 | 688 | 1,530 | | | | | 964 | 1,090 | 1,800 | | 900 | 848 |
| 19 | 740 | 1,670 | | | | | 931 | 786 | 1,780 | | 1,170 | 648 |
| 20 | 1,020 | 1,550 | | | | | 1,330 | 1,030 | 1,230 | | 910 | 648 |
| 21 | 998 | 1,490 | | | | | 1,330 | 1,290 | 1,250 | | 938 | 763 |
| 22 | 976 | 1,510 | | | | | 1,300 | 1,300 | 1,570 | | 837 | 921 |
| 23 | 1,160 | 1,380 | | | | | 1,470 | 982 | 1,140 | | 742 | 916 |
| 24 | 922 | 1,380 | | | | | 1,500 | 962 | 1,140 | | 849 | 928 |
| 25 | 998 | 1,340 | | | | | 1,440 | 1,360 | 1,030 | | 832 | 822 |
| 26 | 1,040 | 1,340 | | | | 3,900 | 995 | 1,490 | 1,170 | | 815 | 582 |
| 27 | 852 | 1,020 | | | | | 1,450 | 1,500 | 918 | 839 | 807 | 614 |
| 28 | 867 | 1,130 | | | | | 1,600 | 1,450 | 1,030 | 793 | 896 | 814 |
| 29 | 947 | 1,050 | | | | | 1,580 | 1,200 | 2,270 | 974 | 1,070 | 686 |
| 30 | 974 | 989 | | | ..... | 3,520 | 1,590 | 690 | 2,270 | 1,240 | 1,140 | 686 |
| 31 | 1,160 | ..... | | | ..... | 3,250 | ..... | 791 | ..... | 1,160 | 1,200 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 10 to Mar. 31, 1919, and Dec. 4, 1919, to Mar. 29, 1920; discharge ascertained by means of gage readings obtained at Hat Rapids bridge and by comparison with flow of Wisconsin River at Merrill, Wis., and Tomahawk River near Bradley, Wis. Operation of water-stage recorder very unsatisfactory Oct. 1 to Dec. 9, 1918, Jan. 4–9, 1919, Apr. 24 to May 25, 1919, July 20–25, 1919, Apr. 4–10, 1920, June 29 to July 26, 1920, and Sept. 29 and 30, 1920; mean discharge ascertained by means of gage heights obtained at Hat Rapids bridge, by fragmentary water-stage recorder records, and by comparison with flow of Tomahawk River near Bradley, Wis., and of Wisconsin River at Merrill, Wis. Operation of water-stage recorder unsatisfactory Apr. 5, Oct. 21, 1919, May 10, and Aug. 25, 1920, discharge interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,160 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | | | 900 | 0.776 | 0.89 |
| November | | | 1,100 | .948 | 1.06 |
| December | | | 952 | .821 | .95 |
| January | 1,160 | 830 | 960 | .828 | .95 |
| February | 1,070 | 790 | 950 | .819 | .85 |
| March | 2,240 | 790 | 1,280 | 1.10 | 1.27 |
| April | 2,660 | | 1,740 | 1.50 | 1.67 |
| May | | | 1,200 | 1.03 | 1.19 |
| June | 2,630 | 651 | 1,550 | 1.34 | 1.50 |
| July | 2,040 | | 1,240 | 1.07 | 1.23 |
| August | 1,480 | 717 | 1,020 | .879 | 1.01 |
| September | 920 | 420 | 740 | .638 | .71 |
| The year | | | 1,140 | .983 | 13.28 |
| 1919–20. | | | | | |
| October | 1,290 | 688 | 941 | .811 | .94 |
| November | 2,140 | 989 | 1,460 | 1.26 | 1.41 |
| December | 1,160 | | 922 | .795 | .92 |
| January | | | 965 | .832 | .96 |
| February | | | 965 | .832 | .90 |
| March | | | 1,860 | 1.60 | 1.84 |
| April | 4,130 | 931 | 1,880 | 1.62 | 1.81 |
| May | 1,540 | 690 | 1,090 | .940 | 1.08 |
| June | 2,270 | 583 | 1,220 | 1.05 | 1.17 |
| July | | | 1,100 | .948 | 1.09 |
| August | 1,200 | 724 | 938 | .809 | .93 |
| September | 956 | 502 | 793 | .684 | .76 |
| The year | 4,130 | 502 | 1,180 | 1.02 | 13.81 |

*Days of deficiency in discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 200 | 0 | | | 0 | | | 0 | 0.0 |
| 300 | 4 | 0 | 0 | 1 | | | 5 | .2 |
| 400 | 9 | 3 | 2 | 7 | 0 | | 21 | 1.0 |
| 500 | 15 | 4 | 10 | 16 | 1 | 0 | 46 | 2.1 |
| 550 | 16 | 5 | 17 | 28 | 3 | 1 | 70 | 3.2 |
| 600 | 19 | 6 | 27 | 37 | 3 | 3 | 95 | 4.3 |
| 650 | 22 | 9 | 34 | 84 | 8 | 7 | 164 | 7.5 |
| 700 | 41 | 13 | 76 | 97 | 13 | 13 | 253 | 11.5 |
| 750 | 47 | 30 | 123 | 169 | 18 | 20 | 407 | 18.6 |
| 800 | 82 | 44 | 132 | 197 | 39 | 35 | 529 | 24.1 |
| 850 | 123 | 51 | 141 | 216 | 49 | 54 | 634 | 28.9 |
| 900 | 131 | 71 | 152 | 229 | 106 | 66 | 755 | 34.4 |
| 950 | 159 | 87 | 168 | 244 | 143 | 124 | 925 | 42.1 |
| 1,000 | 169 | 101 | 181 | 259 | 176 | 203 | 1,089 | 49.7 |
| 1,050 | 196 | 134 | 205 | 294 | 190 | 212 | 1,231 | 56.2 |
| 1,100 | 209 | 143 | 214 | 304 | 227 | 221 | 1,318 | 60.1 |
| 1,200 | 280 | 183 | 249 | 316 | 273 | 280 | 1,581 | 72.1 |
| 1,400 | 326 | 231 | 279 | 337 | 304 | 302 | 1,779 | 81.2 |
| 1,600 | 349 | 261 | 311 | 345 | 324 | 329 | 1,919 | 87.6 |
| 2,000 | 361 | 297 | 340 | 352 | 346 | 344 | 2,040 | 93.1 |
| 2,500 | 364 | 321 | 364 | 361 | 360 | 354 | 2,124 | 96.9 |
| 3,000 | 365 | 337 | 365 | 365 | 365 | 354 | 2,154 | 98.3 |
| 4,000 | 365 | 359 | | | | 365 | 2,184 | 99.6 |
| 6,000 | | 366 | | | | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 1,040 | 1,510 | 1,100 | 906 | 1,140 | 1,180 | | |
| Maximum (sec.-ft.) | 2,780 | 5,100 | 2,680 | | | 4,130 | | |
| Minimum (sec.-ft.) | 270 | 373 | 310 | | | 502 | | |

### WISCONSIN RIVER AT MERRILL, WIS.

LOCATION.—At highway bridge at east end of Merrill, Lincoln County, 1,000 feet below power house of Merrill plant of Wisconsin Valley Lighting Co. and half a mile below mouth of Prairie River, which comes in from left.

DRAINAGE AREA.—2,630 square miles.

RECORDS AVAILABLE.—November 16, 1902, to September 30, 1920.

GAGE.—Stevens water-stage recorder installed September 11, 1914; November 16, 1902, to June 17, 1903, staff gage; June 17, 1903, to September 10, 1914, chain gage attached to downstream side of highway bridge; datum same since June 17, 1903. Records prior to June 17, 1903, questionable. Recorder inspected by O. F. Lueck.

DISCHARGE MEASUREMENTS.—Made from highway bridge a few feet upstream from recording gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock; nearly permanent. Small island below gage and small rapids on either side probably constitute control. Banks fairly high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 9.51 feet at 9.30 p. m. April 11 (discharge, 12,900 second-feet); minimum stage recorded, 3.08 feet at 7 a. m. September 1 (discharge, about 490 second-feet); minimum stage caused by regulation.

Maximum stage recorded during year ending September 30, 1920, 11.42 feet at 5 a. m. March 29 (discharge, 19,200 second-feet); minimum stage recorded, 3.84 feet at 6.30 a. m. August 23 (discharge, 918 second-feet); minimum stage caused by regulation.

1902–1920: Maximum stage recorded, about 17.5 feet at 5 a. m. July 24, 1912 (discharge, about 45,000 second-feet); minimum stage, 2.45 feet September 26, 1908 (discharge, about 90 second-feet).

REGULATION.—Above the gaging station are 17 reservoirs[7] which are operated by Wisconsin Valley Improvement Co. for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is about 6¼ billion cubic feet. In addition to the above reservoirs there are on Wisconsin and Tomahawk rivers above the station eight dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 1,600 and 19,400 second-feet. Operation of water-stage recorder very satisfactory. Daily discharge ascertained by means of discharge integrator except for few days when water-stage recorder was not operating properly, and except for periods, February 1 to March 21, 1919, and December 1, 1919, to March 12, 1920, during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights from water-stage recorder graph, discharge measurements, and weather records. Open-water records good; winter records fair.

*Discharge measurements of Wisconsin River at Merrill, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 10[a] | S. B. Soulé | 4.98 | 2,110 | Jan. 14[a] | S. B. Soulé | 5.66 | 2,230 |
| Feb. 8[a] | do | 4.65 | 1,540 | Feb. 11[a] | do | 5.33 | 2,120 |
| Mar. 5[a] | do | 4.86 | 1,600 | June 9 | do | 5.21 | 2,130 |
| June 2 | W. G. Hoyt | 4.88 | 2,010 | | | | |
| Dec. 10[a] | S. B. Soulé | 5.44 | 2,430 | | | | |

[a] Incomplete ice cover at control.

[7] Information concerning these reservoirs, based on maps and data furnished by the manager of Wisconsin Valley Improvement Co., and data collected by the engineering department of Wisconsin Railroad Commission, is contained in Water-Supply Paper 405, p. 127.

*Daily discharge, in second-feet, of Wisconsin River at Merrill, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 1,870 | 2,050 | 1,580 | 2,190 | 1,920 | 1,720 | 5,600 | 2,840 | 2,310 | 3,790 | 3,900 | 1,100 |
| 2 | 1,680 | 2,120 | 1,340 | 2,270 | 1,950 | 1,630 | 4,560 | 2,930 | 2,060 | 3,350 | 3,520 | 2,040 |
| 3 | 1,780 | 2,260 | 1,980 | 2,100 | 1,700 | 1,660 | 4,520 | 3,250 | 2,230 | 2,940 | 2,660 | 1,840 |
| 4 | 1,680 | 1,780 | 2,000 | 1,980 | 1,950 | 1,780 | 3,780 | 3,580 | 2,000 | 3,150 | 2,510 | 1,980 |
| 5 | 1,670 | 2,040 | 1,860 | 2,200 | 1,960 | 1,720 | 4,320 | 2,470 | 2,080 | 2,550 | 2,980 | 2,010 |
| 6 | 1,540 | 2,080 | 2,100 | 2,060 | 2,000 | 1,640 | 4,800 | 2,560 | 2,290 | 3,400 | 3,650 | 1,840 |
| 7 | 1,480 | 2,820 | 2,060 | 2,140 | 2,050 | 1,680 | 6,050 | 2,870 | 2,370 | 2,920 | 3,740 | 1,810 |
| 8 | 1,900 | 3,440 | 2,030 | 2,180 | 1,740 | 1,650 | 8,840 | 3,190 | 2,630 | 3,400 | 3,370 | 1,310 |
| 9 | 2,360 | 3,500 | 1,950 | 2,180 | 1,680 | 1,600 | 8,960 | 2,700 | 2,440 | 3,580 | 3,140 | 1,840 |
| 10 | 2,340 | 3,340 | 2,160 | 2,160 | 1,830 | 1,530 | 10,600 | 2,960 | 2,590 | 3,310 | 2,460 | 1,560 |
| 11 | 2,440 | 2,970 | 2,120 | 2,350 | 1,720 | 1,670 | 12,500 | 3,190 | 3,510 | 2,870 | 2,600 | 2,000 |
| 12 | 2,350 | 2,940 | 2,050 | 2,140 | 1,760 | 1,660 | 12,200 | 2,740 | 3,070 | 2,520 | 2,230 | 1,820 |
| 13 | 2,200 | 2,900 | 2,340 | 2,100 | 1,840 | 1,640 | 10,400 | 2,410 | 3,040 | 2,540 | 2,680 | 1,840 |
| 14 | 1,700 | 3,080 | 2,180 | 2,000 | 1,640 | 1,610 | 8,640 | 3,110 | 3,520 | 2,490 | 2,600 | 1,580 |
| 15 | 2,240 | 2,830 | 2,160 | 2,100 | 1,570 | 1,750 | 7,890 | 3,210 | 2,120 | 2,480 | 2,360 | 1,480 |
| 16 | 2,070 | 2,510 | 1,920 | 2,100 | 1,730 | 2,270 | 6,960 | 3,580 | 3,700 | 1,940 | 2,270 | 1,350 |
| 17 | 2,140 | 2,660 | 2,070 | 1,990 | 1,680 | 2,480 | 6,250 | 4,080 | 4,090 | 2,000 | 2,480 | 1,430 |
| 18 | 2,000 | 2,380 | 2,080 | 2,080 | 1,800 | 3,200 | 5,980 | 3,900 | 3,300 | 2,060 | 1,880 | 1,500 |
| 19 | 2,060 | 3,250 | 2,080 | 2,040 | 1,700 | 4,160 | 5,340 | 3,460 | 4,880 | 1,950 | 2,070 | 1,500 |
| 20 | 1,920 | 2,800 | 2,120 | 1,680 | 1,840 | 6,040 | 5,020 | 3,240 | 5,060 | 2,080 | 2,310 | 1,500 |
| 21 | 1,480 | 2,730 | 2,260 | 1,970 | 1,740 | 6,230 | 3,880 | 3,010 | 4,560 | 1,850 | 2,300 | 1,360 |
| 22 | 1,800 | 2,340 | 2,740 | 2,120 | 1,750 | 6,460 | 4,560 | 3,320 | 3,490 | 2,310 | 2,360 | 1,290 |
| 23 | 1,970 | 2,160 | 2,680 | 2,080 | 1,680 | 7,000 | 4,160 | 3,470 | 2,710 | 2,110 | 2,310 | 1,510 |
| 24 | 2,140 | 2,400 | 2,610 | 2,080 | 1,700 | 7,600 | 3,160 | 3,720 | 5,790 | 2,070 | 2,560 | 1,650 |
| 25 | 1,960 | 2,320 | 2,540 | 2,120 | 1,720 | 8,200 | 3,240 | 3,120 | 7,700 | 1,940 | 2,000 | 1,540 |
| 26 | 1,770 | 1,960 | 2,480 | 1,900 | 1,730 | 8,800 | 3,440 | 2,970 | 7,100 | 3,120 | 2,130 | 1,480 |
| 27 | 1,830 | 2,070 | 2,610 | 2,030 | 1,750 | 8,950 | 3,200 | 2,320 | 8,300 | 3,770 | 2,280 | 1,430 |
| 28 | 1,730 | 1,960 | 2,500 | 2,100 | 1,660 | 7,960 | 3,000 | 2,160 | 7,200 | 3,510 | 2,060 | 1,460 |
| 29 | 2,460 | 2,060 | 2,100 | 2,060 | ..... | 7,220 | 2,890 | 2,170 | 5,760 | 3,220 | 2,180 | 1,380 |
| 30 | 2,240 | 1,900 | 1,990 | 1,980 | ..... | 6,630 | 2,680 | 2,200 | 3,590 | 3,280 | 2,180 | 1,980 |
| 31 | 1,930 | ..... | 2,330 | 1,990 | ..... | 5,800 | ..... | 3,020 | ..... | 4,140 | 2,310 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 2,350 | 4,490 | 2,050 | 1,770 | 2,320 | 1,600 | 12,200 | 3,930 | 2,250 | 5,630 | 2,170 | 1,600 |
| 2 | 2,750 | 4,130 | 2,070 | 2,090 | 2,180 | 1,940 | 12,800 | 3,620 | 2,280 | 4,420 | 1,490 | 1,760 |
| 3 | 2,490 | 3,720 | 2,090 | 2,320 | 1,970 | 1,620 | 11,300 | 2,990 | 2,260 | 3,830 | 2,080 | 1,670 |
| 4 | 2,300 | 3,570 | 2,100 | 2,380 | 2,070 | 1,660 | 10,700 | 2,860 | 1,940 | 3,830 | 1,780 | 1,610 |
| 5 | 2,240 | 3,730 | 2,120 | 1,970 | 2,150 | 2,620 | 8,980 | 3,190 | 1,960 | 2,610 | 1,630 | 1,640 |
| 6 | 2,040 | 3,820 | 2,040 | 2,270 | 2,090 | 2,220 | 7,890 | 3,020 | 1,720 | 3,280 | 1,870 | 1,420 |
| 7 | 2,220 | 3,100 | 2,130 | 1,950 | 1,880 | 2,190 | 6,960 | 2,680 | 1,270 | 2,700 | 1,730 | 1,160 |
| 8 | 1,880 | 3,040 | 2,310 | 1,880 | 2,020 | 1,900 | 6,610 | 2,420 | 2,230 | 3,310 | 2,450 | 1,440 |
| 9 | 2,060 | 3,160 | 2,140 | 1,900 | 1,930 | 1,630 | 5,880 | 2,440 | 2,190 | 2,940 | 1,270 | 1,530 |
| 10 | 2,240 | 6,220 | 2,320 | 2,090 | 2,080 | 1,880 | 5,200 | 1,700 | 1,840 | 3,070 | 2,190 | 1,460 |
| 11 | 2,020 | 8,050 | 2,640 | 2,030 | 2,200 | 2,090 | 5,470 | 2,920 | 2,550 | 2,500 | 2,130 | 1,560 |
| 12 | 2,170 | 6,870 | 2,460 | 1,850 | 1,980 | 2,500 | 5,120 | 3,150 | 3,380 | 2,300 | 2,230 | 1,880 |
| 13 | 1,430 | 5,690 | 2,400 | 2,040 | 1,910 | 2,630 | 4,840 | 2,990 | 3,910 | 1,990 | 2,000 | 1,320 |
| 14 | 2,020 | 4,510 | 2,410 | 2,290 | 1,880 | 2,450 | 4,690 | 2,850 | 3,350 | 2,660 | 2,060 | 1,420 |
| 15 | 2,070 | 4,320 | 2,160 | 2,160 | 2,270 | 2,010 | 3,850 | 2,660 | 4,000 | 1,950 | 2,390 | 1,700 |
| 16 | 1,930 | 4,490 | 2,070 | 1,840 | 1,910 | 2,370 | 3,740 | 1,860 | 7,130 | 2,490 | 1,120 | 1,820 |
| 17 | 1,850 | 3,020 | 1,940 | 2,030 | 1,820 | 2,190 | 3,830 | 2,400 | 6,910 | 1,620 | 2,170 | 1,780 |
| 18 | 1,860 | 3,290 | 1,970 | 1,990 | 1,920 | 2,510 | 3,830 | 2,550 | 6,730 | 1,820 | 1,620 | 1,730 |
| 19 | 1,860 | 3,170 | 2,000 | 1,810 | 2,080 | 2,710 | 3,480 | 2,900 | 5,930 | 1,840 | 1,940 | 1,760 |
| 20 | 1,440 | 3,090 | 2,050 | 1,950 | 1,840 | 2,680 | 3,000 | 2,850 | 4,510 | 1,790 | 1,940 | 1,480 |
| 21 | 1,850 | 2,860 | 1,900 | 1,890 | 1,680 | 3,140 | 3,440 | 3,390 | 3,050 | 1,640 | 1,670 | 1,620 |
| 22 | 1,950 | 2,760 | 1,800 | 1,880 | 1,950 | 2,360 | 3,660 | 3,380 | 3,390 | 1,620 | 2,180 | 1,650 |
| 23 | 2,080 | 2,720 | 1,880 | 1,970 | 1,740 | 4,070 | 6,030 | 5,220 | 3,190 | 1,600 | 1,050 | 1,710 |
| 24 | 2,390 | 2,550 | 1,940 | 1,890 | 1,970 | 6,770 | 6,540 | 3,830 | 2,640 | 1,800 | 1,600 | 1,660 |
| 25 | 2,060 | 2,370 | 2,010 | 2,030 | 1,850 | 9,540 | 6,450 | 4,080 | 2,380 | 2,110 | 1,710 | 1,700 |
| 26 | 2,210 | 2,030 | 1,680 | 1,870 | 2,020 | 13,400 | 4,980 | 3,970 | 2,400 | 2,030 | 1,530 | 1,690 |
| 27 | 2,160 | 1,770 | 1,780 | 2,120 | 2,280 | 17,700 | 4,940 | 3,760 | 2,850 | 1,880 | 1,460 | 1,400 |
| 28 | 2,160 | 2,050 | 1,860 | 1,910 | 2,280 | 17,000 | 5,050 | 3,140 | 2,730 | 1,600 | 1,460 | 1,630 |
| 29 | 1,980 | 2,140 | 1,610 | 1,930 | 1,960 | 18,700 | 4,420 | 2,070 | 5,570 | 2,430 | 1,700 | 1,570 |
| 30 | 2,490 | 2,240 | 2,360 | 1,960 | ..... | 16,400 | 4,340 | 2,630 | 5,760 | 1,780 | 1,380 | 1,540 |
| 31 | 3,990 | ..... | 1,700 | 2,100 | ..... | 13,400 | ..... | 1,650 | ..... | 2,560 | 1,670 | ..... |

NOTE.—Discharge estimated or interpolated on account of faulty operation of water-stage recorder, Dec. 23–25, 1918, Mar. 24, 25, July 17, and Sept. 4, 1919.

*Monthly discharge of Wisonsin River at Merrill, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,630 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,460 | 1,480 | 1,960 | 0.745 | 0.86 |
| November | 3,500 | 1,780 | 2,520 | .958 | 1.07 |
| December | 2,740 | 1,340 | 2,160 | .821 | .95 |
| January | 2,350 | 1,680 | 2,080 | .791 | .91 |
| February | 2,050 | 1,570 | 1,780 | .677 | .70 |
| March | 8,950 | 1,530 | 4,000 | 1.52 | 1.75 |
| April | 12,500 | 2,680 | 5,910 | 2.25 | 2.51 |
| May | 4,080 | 2,160 | 3,020 | 1.15 | 1.33 |
| June | 8,300 | 2,000 | 3,850 | 1.46 | 1.63 |
| July | 4,140 | 1,850 | 2,790 | 1.06 | 1.22 |
| August | 3,900 | 1,880 | 2,580 | .981 | 1.13 |
| September | 2,040 | 1,100 | 1,610 | .612 | .68 |
| The year | 12,500 | 1,100 | 2,860 | 1.09 | 14.74 |
| 1919–20. | | | | | |
| October | 3,990 | 1,430 | 2,150 | .817 | .94 |
| November | 8,050 | 1,770 | 3,630 | 1.38 | 1.54 |
| December | 2,640 | 1,610 | 2,060 | .783 | .90 |
| January | 2,380 | 1,770 | 2,010 | .764 | .88 |
| February | 2,320 | 1,680 | 2,010 | .764 | .82 |
| March | 18,700 | 1,600 | 5,350 | 2.03 | 2.34 |
| April | 12,800 | 3,000 | 6,010 | 2.29 | 2.56 |
| May | 5,220 | 1,650 | 3,000 | 1.14 | 1.31 |
| June | 7,130 | 1,270 | 3,410 | 1.30 | 1.45 |
| July | 5,630 | 1,600 | 2,470 | .939 | 1.08 |
| August | 2,450 | 1,050 | 1,800 | .684 | .79 |
| September | 1,880 | 1,160 | 1,600 | .608 | .68 |
| The year | 18,700 | 1,050 | 2,960 | 1.13 | 15.29 |

*Days of deficiency in discharge of Wisconsin River at Merrill, Wis., for the years ending Sept. 30, 1907–1920.*

| Discharge in sec.-ft. | Days of deficient discharge. | | | | | | | | | | | | | | Oct. 1, 1906, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1906–7.[a] | 1907–8. | 1908–9. | 1909–10. | 1910–11. | 1911–12.[b] | 1912–13. | 1913–14. | 1914–15. | 1915–16. | 1916–17. | 1917–18. | 1918–19. | 1919–20. | Total days. | |
| 300 | ..... | 12 | 4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 16 | 0.3 |
| 500 | 2 | 16 | 9 | 6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 33 | .6 |
| 700 | 6 | 25 | 13 | 21 | 6 | ..... | ..... | ..... | ..... | ..... | ..... | 1 | ..... | ..... | 72 | 1.4 |
| 900 | 13 | 34 | 20 | 31 | 17 | 2 | 1 | 1 | 1 | ..... | ..... | 1 | ..... | ..... | 130 | 2.7 |
| 1,100 | 21 | 58 | 37 | 67 | 49 | 3 | 2 | 2 | 1 | ..... | ..... | 6 | 1 | 1 | 248 | 4.8 |
| 1,300 | 33 | 94 | 86 | 106 | 106 | 4 | 2 | 9 | 21 | ..... | 6 | 102 | 2 | 5 | 576 | 11.3 |
| 1,500 | 43 | 131 | 153 | 136 | 161 | 11 | 9 | 13 | 74 | 1 | 49 | 164 | 17 | 18 | 980 | 19.2 |
| 1,700 | 56 | 171 | 204 | 152 | 200 | 18 | 14 | 30 | 121 | 7 | 101 | 207 | 49 | 50 | 1,330 | 27.0 |
| 1,900 | 104 | 213 | 234 | 173 | 233 | 117 | 42 | 87 | 162 | 54 | 142 | 227 | 85 | 101 | 1,974 | 38.6 |
| 2,100 | 138 | 234 | 261 | 217 | 252 | 122 | 75 | 115 | 186 | 119 | 181 | 241 | 154 | 170 | 2,465 | 48.2 |
| 2,300 | 171 | 249 | 268 | 258 | 282 | 163 | 144 | 160 | 209 | 149 | 202 | 260 | 193 | 210 | 2,898 | 56.7 |
| 2,500 | 192 | 261 | 278 | 267 | 267 | 169 | 162 | 174 | 226 | 170 | 220 | 279 | 224 | 239 | 3,128 | 61.2 |
| 2,700 | 218 | 264 | 281 | 277 | 281 | 173 | 185 | 208 | 253 | 187 | 239 | 294 | 244 | 256 | 3,360 | 65.7 |
| 2,900 | 230 | 270 | 286 | 281 | 288 | 182 | 202 | 216 | 266 | 203 | 252 | 301 | 256 | 267 | 3,500 | 68.5 |
| 3,100 | 242 | 273 | 291 | 284 | 296 | 190 | 216 | 254 | 280 | 217 | 270 | 312 | 270 | 279 | 3,674 | 71.9 |
| 3,500 | 265 | 286 | 300 | 296 | 306 | 208 | 243 | 286 | 303 | 234 | 297 | 326 | 301 | 296 | 3,947 | 77.2 |
| 4,000 | 286 | 293 | 307 | 320 | 325 | 225 | 272 | 300 | 319 | 262 | 313 | 344 | 320 | 314 | 4,200 | 82.1 |
| 4,500 | 295 | 297 | 316 | 340 | 330 | 237 | 287 | 311 | 334 | 283 | 327 | 355 | 325 | 324 | 4,361 | 85.3 |
| 5,000 | 300 | 305 | 323 | 352 | 345 | 258 | 310 | 326 | 339 | 294 | 344 | 358 | 331 | 330 | 4,515 | 88.3 |
| 7,000 | 342 | 346 | 342 | 363 | 363 | 300 | 335 | 353 | 362 | 321 | 365 | 365 | 347 | 351 | 4,855 | 95.0 |
| 10,000 | 359 | 332 | 362 | 365 | 365 | 346 | 361 | 362 | 365 | 349 | ..... | ..... | 361 | 356 | 5,043 | 98.6 |
| 15,000 | 365 | 366 | 365 | ..... | ..... | 359 | 365 | 365 | ..... | 362 | ..... | ..... | 365 | 362 | 5,099 | 99.7 |
| 20,000 | ..... | ..... | ..... | ..... | ..... | 363 | ..... | ..... | ..... | 364 | ..... | ..... | ..... | 366 | 5,109 | 99.9 |
| 30,000 | ..... | ..... | ..... | ..... | ..... | 366 | ..... | ..... | ..... | 366 | ..... | ..... | ..... | ..... | 5,114 | 100.0 |

[a] Mean discharge December, 1906, estimated 1,890 second-feet.

[b] Mean discharge estimated, December, 1,890 second-feet, January, 1,870 second-feet, February, 1,890 second-feet, and March, 2,340 second-feet.

### WISCONSIN RIVER NEAR NEKOOSA, WIS.

LOCATION.—In sec. 15, T. 21 N., R. 5 E., 1½ miles below Nekoosa, Wood County. Tenmile Creek enters from left 4 miles below station, and Big Roche a Cri Creek, also from left, 38 miles below.

DRAINAGE AREA.—5,500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch =6 miles).

RECORDS AVAILABLE.—May 21, 1914, to September 30, 1920.

GAGE.—Stevens water-stage recorder, installed July 18, 1916, in wooden shelter on right bank; prior to that date Gurley water-stage recorder at same location. Gage attended by Henry Mans.

DISCHARGE MEASUREMENTS.—Made from cable a short distance upstream from gage house.

CHANNEL AND CONTROL.—Bed composed of gravel; clean; practically permanent. Banks are high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 10.6 feet at 7 a. m. June 27 (discharge, 26,900 second-feet); minimum stage recorded, 0.71 foot at 8 p. m. October 6 and 8 p. m. September 2 (discharge, 913 second-feet).

Maximum stage recorded during year ending September 30, 1920, 15.1 feet at noon March 28 (discharge, 52,900 second-feet); minimum stage recorded, 0.6 foot at 12.30 p. m. September 7 (discharge, 1,010 second-feet).

1914–1920: Maximum stage recorded, about 15.3 feet during the flood of June 6–9, 1914, as determined by levels run to high-water marks after water had receded (discharge, about 54,000 second-feet); minimum stage recorded, 0.45 foot at 11 a. m. November 7, 1915 (discharge, 595 second-feet); minimum flow is caused by regulation.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No storage reservoirs discharge into Wisconsin River between Nekoosa and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 138). Between Nekoosa and Merrill are 12 dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 1,450 and 52,000 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by means of discharge integrator except for few short periods when operation of water-stage recorder was unsatisfactory, and except for periods December 23, 1918, to March 31, 1919, and December 1, 1919, to March 9, 1920, during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by means of weather records and comparison with flow of this river at Merrill, Wis. Open-water records excellent; winter records fair.

*Discharge measurements of Wisconsin River near Nekoosa, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Feb. 19[a] | S. B. Soulé | 1.83 | 1,870 | June 8 | S. B. Soulé | 1.06 | 1,540 |
| Mar. 14[a] | do | 4.00 | 4,180 | Aug. 2 | do | 1.44 | 2,000 |
| June 3 | W. G. Hoyt | 3.20 | 5,400 | | | | |

[a] Incomplete ice cover at control.

*Daily discharge, in second-feet, of Wisconsin River near Nekoosa, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 1,640 | 4,000 | 3,010 | | | | 10,800 | 4,840 | 3,100 | 8,150 | 12,000 | 4,970 |
| 2 | 2,820 | 3,720 | 2,570 | | | | 9,940 | 6,010 | 3,770 | 6,010 | 13,200 | 1,560 |
| 3 | 2,640 | 3,320 | 1,880 | | | | 8,840 | 7,580 | 4,400 | 6,020 | 10,500 | 2,180 |
| 4 | 2,710 | 3,280 | 3,160 | | | | 8,050 | 6,870 | 4,900 | 5,480 | 7,600 | 2,920 |
| 5 | 2,900 | 3,570 | 2,580 | | | | 8,340 | 7,340 | 4,950 | 5,560 | 7,300 | 3,460 |
| 6 | 3,020 | 3,740 | 2,750 | | | | 8,040 | 6,710 | 4,380 | 5,290 | 8,520 | 3,640 |
| 7 | 1,460 | 3,620 | 2,940 | | | | 12,600 | 7,780 | 4,360 | 3,920 | 9,010 | 3,300 |
| 8 | 1,700 | 3,360 | 2,730 | | | | 14,200 | 7,600 | 4,860 | 4,900 | 11,100 | 2,460 |
| 9 | 2,350 | 4,350 | 3,100 | | | | 21,200 | 8,040 | 4,980 | 4,660 | 11,600 | 2,770 |
| 10 | 2,760 | 5,350 | 2,440 | | | | 21,500 | 6,880 | 5,460 | 4,710 | 10,200 | 3,260 |
| 11 | 3,020 | 4,720 | 3,700 | | | | 21,400 | 5,800 | 6,360 | 5,260 | 6,930 | 2,770 |
| 12 | 3,010 | 4,820 | 3,260 | | | | 19,800 | 6,000 | 9,640 | 4,960 | 5,900 | 2,760 |
| 13 | 4,090 | 4,510 | 3,390 | | | | 19,100 | 5,200 | 9,320 | 4,320 | 5,220 | 2,500 |
| 14 | 2,630 | 4,030 | 3,660 | | | | 22,900 | 4,740 | 8,480 | 3,470 | 4,680 | 2,400 |
| 15 | 2,000 | 4,500 | 3,560 | | 2,670 | | 19,700 | 4,520 | 6,810 | 3,860 | 4,920 | 1,840 |
| 16 | 3,160 | 4,480 | 3,530 | 2,910 | | 6,400 | 15,500 | 4,170 | 7,880 | 4,640 | 4,520 | 1,880 |
| 17 | 2,630 | 4,200 | 3,490 | | | | 13,900 | 4,340 | 5,020 | 4,030 | 4,720 | 2,400 |
| 18 | 2,780 | 4,120 | 3,840 | | | | 13,400 | 5,110 | 9,430 | 3,810 | 3,970 | 2,460 |
| 19 | 2,880 | 4,220 | 3,680 | | | | 12,500 | 5,640 | 7,100 | 3,560 | 4,230 | 2,640 |
| 20 | 3,120 | 4,200 | 3,540 | | | | 11,400 | 5,140 | 8,260 | 3,150 | 4,240 | 2,560 |
| 21 | 2,260 | 4,700 | 3,720 | | | | 11,000 | 4,740 | 10,300 | 2,740 | 3,690 | 2,220 |
| 22 | 2,850 | 4,720 | 3,940 | | | | 9,580 | 4,480 | 10,900 | 1,820 | 3,720 | 2,540 |
| 23 | 2,360 | 4,080 | | | | | 8,640 | 4,420 | 7,700 | 2,780 | 4,060 | 1,980 |
| 24 | 2,460 | 3,720 | | | | | 8,250 | 3,980 | 10,200 | 3,350 | 4,460 | 2,930 |
| 25 | 2,560 | 3,170 | | | | | 7,150 | 3,960 | 16,500 | 2,580 | 3,320 | 2,140 |
| 26 | 2,560 | 2,960 | 3,500 | | | | 5,650 | 5,020 | 23,800 | 3,140 | 3,850 | 2,110 |
| 27 | 2,810 | 3,720 | | | | | 5,760 | 4,840 | 25,700 | 3,730 | 4,000 | 2,120 |
| 28 | 2,760 | 3,060 | | | | | 5,740 | 4,460 | 21,800 | 5,600 | 3,660 | 2,740 |
| 29 | 3,110 | 2,850 | | | ..... | | 5,970 | 4,140 | 15,500 | 6,580 | 3,050 | 1,910 |
| 30 | 4,000 | 1,860 | | | ..... | | 5,020 | 3,380 | 11,000 | 5,820 | 3,480 | 1,700 |
| 31 | 3,910 | ..... | | | ..... | | ..... | 3,570 | ..... | 7,190 | 3,280 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 2,600 | 15,100 | | | | | 33,900 | 7,130 | 4,420 | 8,540 | 2,220 | 2,130 |
| 2 | 3,500 | 18,000 | | | | | 30,700 | 6,760 | 4,280 | 8,160 | 2,150 | 1,710 |
| 3 | 4,540 | 15,600 | | | | | 27,700 | 6,060 | 3,200 | 7,150 | 1,500 | 2,290 |
| 4 | 5,080 | 12,600 | | | | | 24,700 | 5,820 | 3,240 | 6,180 | 3,420 | 2,380 |
| 5 | 4,490 | 10,800 | | | | 3,280 | 21,700 | 5,240 | 3,540 | 5,060 | 2,760 | 1,980 |
| 6 | 4,680 | 9,800 | | | | | 18,700 | 3,460 | 3,360 | 5,140 | 2,600 | 2,030 |
| 7 | 3,980 | 9,250 | | | | | 15,700 | 3,720 | 2,980 | 4,350 | 2,320 | 1,740 |
| 8 | 3,860 | 8,080 | | | | | 12,700 | 4,540 | 1,720 | 5,220 | 2,080 | 1,830 |
| 9 | 3,580 | 7,460 | | | | | 9,940 | 4,760 | 3,150 | 5,180 | 2,730 | 2,660 |
| 10 | 4,060 | 8,630 | | | | 6,220 | 9,560 | 3,360 | 3,210 | 4,600 | 1,780 | 2,400 |
| 11 | 3,380 | 15,300 | | | | 6,930 | 9,640 | 4,860 | 3,210 | 4,570 | 2,920 | 2,450 |
| 12 | 3,480 | 25,700 | | | | 7,040 | 9,560 | 5,880 | 3,760 | 4,450 | 2,790 | 1,690 |
| 13 | 3,560 | 26,100 | | | | 5,730 | 7,680 | 8,040 | 6,270 | 3,060 | 2,920 | 1,730 |
| 14 | 2,560 | 20,600 | | | | 6,630 | 8,440 | 7,200 | 7,840 | 4,400 | 2,550 | 1,520 |
| 15 | 3,410 | 13,100 | | | 2,970 | 5,260 | 7,180 | 6,480 | 7,080 | 3,540 | 2,420 | 2,060 |
| 16 | 3,390 | 10,800 | 3,290 | 2,810 | | 7,280 | 7,150 | 5,450 | 7,300 | 3,000 | 2,120 | 2,550 |
| 17 | 2,820 | 9,980 | | | | 8,400 | 6,440 | 4,920 | 11,500 | 2,940 | 2,110 | 2,480 |
| 18 | 3,360 | 9,200 | | | | 9,470 | 6,050 | 4,830 | 15,700 | 2,700 | 2,740 | 2,520 |
| 19 | 2,980 | 7,220 | | | | 11,900 | 5,750 | 4,760 | 14,900 | 2,540 | 2,540 | 2,260 |
| 20 | 2,560 | 7,030 | | | | 14,300 | 6,390 | 4,850 | 11,500 | 1,980 | 1,820 | 2,250 |
| 21 | 2,700 | 6,170 | | | | 13,900 | 5,530 | 5,040 | 9,020 | 3,020 | 2,290 | 1,670 |
| 22 | 3,560 | 6,160 | | | | 13,500 | 5,610 | 5,990 | 6,120 | 2,640 | 2,060 | 2,500 |
| 23 | 2,980 | 6,220 | | | | 13,100 | 7,570 | 6,260 | 5,260 | 2,560 | 2,260 | 2,620 |
| 24 | 3,410 | 6,300 | | | | 14,800 | 11,000 | 8,540 | 5,430 | 3,230 | 1,570 | 2,300 |
| 25 | 3,330 | 5,170 | | | | 23,200 | 14,800 | 10,600 | 5,120 | 2,480 | 2,680 | 2,380 |
| 26 | 4,920 | 4,340 | | | | 25,000 | 13,900 | 8,420 | 4,360 | 2,480 | 2,460 | 2,030 |
| 27 | 5,850 | 3,560 | | | | 46,600 | 11,800 | 7,380 | 4,080 | 1,520 | 1,920 | 2,060 |
| 28 | 5,150 | 3,640 | | | | 51,700 | 9,240 | 6,180 | 3,660 | 2,220 | 1,970 | 1,530 |
| 29 | 4,940 | 3,180 | | | | 46,600 | 8,860 | 6,130 | 4,320 | 1,980 | 2,260 | 2,420 |
| 30 | 5,430 | 2,960 | | | ..... | 44,100 | 8,100 | 6,160 | 5,830 | 2,380 | 2,280 | 2,040 |
| 31 | 7,640 | ..... | | | ..... | 41,200 | ..... | 2,940 | ..... | 2,600 | 1,500 | ..... |

NOTE.—Discharge interpolated on account of faulty operation of water-stage recorder, Oct. 1, 1919, Mar. 21, 22, 1920, and Apr. 2–7, 1920. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Wisconsin River near Nekoosa, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 5,500 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 4,090 | 1,460 | 2,740 | 0.498 | 0.57 |
| November | 5,350 | 1,860 | 3,800 | .709 | .79 |
| December | | | 3,290 | .598 | .69 |
| January | | | 2,910 | .529 | .61 |
| February | | | 2,670 | .485 | .50 |
| March | | | 6,400 | 1.16 | 1.34 |
| April | 22,900 | 5,020 | 12,200 | 2.22 | 2.48 |
| May | 8,040 | 3,380 | 5,400 | .982 | 1.13 |
| June | 25,700 | 3,100 | 9,230 | 1.68 | 1.87 |
| July | 8,150 | 1,820 | 4,550 | .827 | .95 |
| August | 13,200 | 3,050 | 6,160 | 1.12 | 1.29 |
| September | 4,970 | 1,560 | 2,570 | .467 | .52 |
| The year | 25,700 | | 5,170 | .940 | 12.74 |
| 1919–20. | | | | | |
| October | 7,640 | 2,560 | 3,930 | .715 | .82 |
| November | 26,100 | 2,960 | 10,300 | 1.87 | 2.09 |
| December | | | 3,290 | .598 | .69 |
| January | | | 2,810 | .511 | .59 |
| February | | | 2,970 | .540 | .58 |
| March | 51,700 | | 14,600 | 2.65 | 3.06 |
| April | 33,900 | 5,530 | 12,500 | 2.27 | 2.53 |
| May | 10,600 | 2,940 | 5,860 | 1.07 | 1.23 |
| June | 15,700 | 1,720 | 5,850 | 1.06 | 1.18 |
| July | 8,540 | 1,520 | 3,870 | .704 | .81 |
| August | 3,420 | 1,500 | 2,310 | .420 | .48 |
| September | 2,660 | 1,520 | 2,140 | .389 | .43 |
| The year | 51,700 | 1,500 | 5,860 | 1.07 | 14.49 |

*Days of deficiency in discharge of Wisconsin River near Nekoosa, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 1,200 | 0 | | | 0 | | | 0 | 0.0 |
| 1,400 | 1 | 0 | 0 | 5 | 0 | 0 | 6 | .3 |
| 1,600 | 2 | 3 | 3 | 8 | 2 | 6 | 24 | 1.1 |
| 1,800 | 33 | 9 | 12 | 21 | 5 | 13 | 93 | 4.2 |
| 2,000 | 44 | 16 | 17 | 41 | 13 | 20 | 151 | 6.9 |
| 2,200 | 70 | 23 | 32 | 58 | 17 | 31 | 231 | 10.5 |
| 2,400 | 97 | 63 | 52 | 93 | 23 | 45 | 373 | 17.0 |
| 2,600 | 115 | 84 | 87 | 120 | 35 | 62 | 503 | 22.9 |
| 2,800 | 129 | 101 | 111 | 158 | 79 | 75 | 653 | 29.8 |
| 3,000 | 161 | 115 | 131 | 177 | 120 | 144 | 848 | 38.7 |
| 3,200 | 171 | 128 | 148 | 195 | 135 | 149 | 926 | 42.2 |
| 3,400 | 184 | 143 | 165 | 212 | 146 | 200 | 1,040 | 47.4 |
| 3,600 | 191 | 155 | 176 | 226 | 155 | 212 | 1,125 | 51.3 |
| 3,800 | 213 | 167 | 196 | 233 | 180 | 216 | 1,205 | 55.0 |
| 4,000 | 225 | 173 | 205 | 241 | 193 | 218 | 1,255 | 57.3 |
| 4,400 | 251 | 206 | 228 | 252 | 212 | 226 | 1,375 | 62.7 |
| 4,800 | 272 | 217 | 253 | 268 | 231 | 236 | 1,477 | 67.4 |
| 5,200 | 277 | 223 | 271 | 282 | 248 | 250 | 1,551 | 70.8 |
| 6,000 | 291 | 239 | 287 | 298 | 265 | 266 | 1,646 | 75.1 |
| 8,000 | 328 | 275 | 310 | 322 | 317 | 303 | 1,855 | 84.6 |
| 10,000 | 341 | 304 | 321 | 330 | 334 | 325 | 1,955 | 89.2 |
| 15,000 | 355 | 328 | 341 | 349 | 352 | 344 | 2,069 | 94.4 |
| 20,000 | 365 | 343 | 360 | 355 | 358 | 351 | 2,131 | 97.2 |
| 30,000 | | 358 | 365 | 362 | 365 | 359 | 2,174 | 99.2 |
| 50,000 | | 366 | | 365 | | 365 | 2,191 | 99.95 |
| 80,000 | | | | | | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 4,410 | 6,830 | 5,230 | 4,790 | 5,170 | 5,860 | | |
| Maximum (sec.-ft.) | 19,900 | 49,700 | 23,600 | 33,200 | 25,700 | 51,700 | | |
| Minimum (sec.-ft.) | a 1,550 | 1,440 | 1,430 | 1,350 | a 1,460 | | | |

a Approximate.

### WISCONSIN RIVER AT MUSCODA, WIS.

LOCATION.—In sec. 1, T. 8 N., R. 1 W., at highway bridge 1 mile north of Muscoda, Grant County. Eagle Mill Creek enters from right half a mile below station, and Underwood Creek from left, 4½ miles above.

DRAINAGE AREA.—10,300 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.)

RECORDS AVAILABLE.—December 20, 1902, to December 31, 1903; December 1, 1913, to September 30, 1920. Gage heights November 1, 1908, to December 31, 1912, published in United States Weather Bureau bulletin, Daily River Stages, parts 9, 10, and 11.

GAGE.—Chain gage fastened to handrail on upstream side of bridge; read by William Hessler. Elevation of zero of present gage about 12.62 feet above that of gage maintained December 20, 1902, to December 31, 1913; elevation of gage during period November, 1908, to December 31, 1913, as read and published by United States Weather Bureau was approximately the same as that of present gage, sea-level elevation of which is about 666.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 7.98 feet at 5 p. m. April 16 (discharge, about 42,300 second-feet); minimum stage recorded, 0.96 foot at 5 p. m. October 14 (discharge, about 3,550 second-feet); water apparently held in service reservoir of Prairie du Sac dam.

Maximum stage recorded during year ending September 30, 1920, 10.10 feet at 5 p. m. April 2 (discharge, 64,400 second-feet); minimum stage recorded, 0.44 foot at 5 p. m. September 27 (discharge, 3,130 second-feet).

1903 and 1914–1920: Maximum stage recorded, 10.10 feet April 2, 1920 (discharge, 64,400 second-feet); minimum discharge, estimated 2,000 second-feet February 11, 1918 (stage-discharge relation affected by ice); water apparently held back in service reservoir of Prairie du Sac dam.

According to records of United States Weather Bureau [8] (see note under "Gage") on June 11, 1881, the river reached a stage of 11.1 feet, and during August, 1868, zero on gage; discharge not determined owing to probable changes in channel and datum of gage.

REGULATION.—Nearest power plant above station is at Prairie du Sac, about 40 miles distant; since latter part of 1915 considerable diurnal fluctuation has been observed at gage. Owing to regulation by storage in the headwaters, the flow at this station is not natural.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice. Two rating curves used during 1919 and 1920; one applicable October 1 to March 14, 1919, fairly well defined between 3,810 and 15,900 second-feet and poorly defined outside these limits; the other used as basic curve for the indirect method for shifting channel and applicable March 15 to November 30, 1919, and March 23 to September 30, 1920, fairly well defined between 5,200 and 45,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair; winter records poor.

*Discharge measurements of Wisconsin River at Muscoda, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 16 | S. B. Soulé | 1.30 | 4,430 | Jan. 27[a] | Hoyt and Harris | 3.26 | 5,320 |
| 1919. | | | | Feb. 28[b] | do | 3.12 | 5,280 |
| Apr. 2 | Hoyt and Soulé | 5.45 | 22,800 | Apr. 6 | S. B. Soulé | 8.42 | 45,700 |
| June 17 | S. B. Soulé | 3.98 | 14,200 | May 20 | W. G. Hoyt | 2.85 | 9,660 |
| Oct. 9 | do | 2.15 | 6,370 | Sept. 21 | S. B. Soulé | 1.04 | 4,900 |
| Dec. 23[a] | Hoyt and Harris | 3.50 | 6,580 | | | | |

[a] Complete ice cover at control.

[b] Small amount of open water at control.

[8] Daily River Stages, pt. 10, p. 98.

*Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1..... | 4,750 | 4,750 | 5,330 | | | | 19,700 | 13,000 | 6,700 | 22,500 | 7,400 | 5,480 |
| 2..... | 5,030 | 4,750 | 5,030 | | | | 21,900 | 12,200 | 7,040 | 24,400 | 9,700 | 6,060 |
| 3..... | 5,030 | 5,030 | 5,330 | | | | 22,500 | 11,300 | 8,140 | 24,400 | 8,140 | 5,480 |
| 4..... | 4,750 | 4,250 | 5,330 | | | | 18,200 | 11,300 | 8,520 | 17,200 | 9,700 | 5,480 |
| 5..... | 4,750 | 4,750 | 5,030 | | | | 16,200 | 10,100 | 6,380 | 12,600 | 13,900 | 5,760 |
| 6..... | 4,490 | 4,750 | 5,030 | | | | 15,800 | 13,000 | 8,520 | 12,200 | 14,400 | 5,480 |
| 7..... | 3,810 | 5,330 | 4,490 | | | | 14,800 | 13,900 | 8,900 | 11,300 | 11,800 | 4,940 |
| 8..... | 4,250 | 5,980 | 4,750 | | | 5,050 | 14,800 | 13,500 | 9,300 | 9,700 | 10,100 | 4,220 |
| 9..... | 4,750 | 5,330 | 4,020 | | 5,650 | | 13,000 | 13,000 | 8,140 | 8,520 | 12,600 | 4,940 |
| 10..... | 4,750 | 6,640 | 5,030 | | | | 15,300 | 13,900 | 8,140 | 8,140 | 9,700 | 5,760 |
| 11..... | 4,490 | 5,650 | 5,030 | | | | 18,200 | 16,200 | 7,760 | 8,140 | 11,800 | 5,760 |
| 12..... | 4,020 | 5,330 | 5,330 | | | | 20,800 | 15,300 | 11,800 | 8,140 | 14,400 | 4,940 |
| 13..... | 4,250 | 5,980 | 5,980 | | | | 23,100 | 15,300 | 11,300 | 8,140 | 14,400 | 4,690 |
| 14..... | 3,620 | 5,980 | 5,980 | | | | 25,100 | 13,500 | 9,300 | 7,400 | 11,300 | 4,940 |
| 15..... | 4,020 | 6,310 | 6,310 | | | 8,140 | 32,400 | 11,300 | 12,200 | 7,760 | 7,760 | 4,450 |
| 16..... | 4,490 | 5,980 | 6,310 | 6,550 | | 15,800 | 41,500 | 10,500 | 13,900 | 7,760 | 6,380 | 4,940 |
| 17..... | 4,490 | 6,640 | 6,980 | | 6,980 | 18,700 | 36,800 | 10,500 | 14,400 | 7,040 | 9,700 | 4,690 |
| 18..... | 4,250 | 5,980 | 5,980 | | 7,660 | 17,700 | 40,500 | 8,900 | 12,200 | 5,760 | 8,900 | 4,690 |
| 19..... | 4,490 | 6,310 | 6,310 | | 7,320 | 16,200 | 39,500 | 7,040 | 10,500 | 6,060 | 6,060 | 5,200 |
| 20..... | 4,490 | 6,310 | 6,310 | | 6,310 | 15,300 | 30,800 | 10,100 | 13,000 | 6,060 | 6,380 | 5,200 |
| 21..... | 3,620 | 6,310 | 6,310 | | 5,650 | 19,200 | 23,800 | 9,700 | 12,600 | 6,060 | 6,700 | 5,200 |
| 22..... | 4,490 | 6,310 | 6,310 | | 5,650 | 22,500 | 22,500 | 7,760 | 11,800 | 6,700 | 6,060 | 4,940 |
| 23..... | 4,490 | 5,980 | 5,030 | | 5,330 | 25,100 | 21,900 | 8,140 | 11,300 | 6,060 | 6,380 | 4,940 |
| 24..... | 4,490 | 5,980 | 5,330 | | 4,750 | 27,800 | 19,700 | 10,100 | 11,300 | 6,060 | 6,060 | 4,940 |
| 25..... | 4,750 | 5,030 | | | 5,650 | 26,400 | 20,800 | 9,300 | 14,400 | 6,060 | 6,700 | 4,940 |
| 26..... | 4,490 | 6,310 | | | 5,700 | 26,400 | 18,700 | 6,380 | 14,800 | 5,480 | 6,700 | 4,690 |
| 27..... | 5,030 | 6,310 | | | 5,700 | 26,400 | 13,500 | 8,140 | 13,000 | 4,690 | 6,060 | 4,450 |
| 28..... | 4,250 | 6,310 | 6,300 | | 5,700 | 28,500 | 13,900 | 9,300 | 13,500 | 4,450 | 5,200 | 4,690 |
| 29..... | 5,030 | 5,330 | | | ..... | 27,800 | 14,800 | 7,400 | 18,200 | 4,940 | 5,200 | 5,200 |
| 30..... | 4,750 | 6,310 | | | ..... | 27,100 | 13,500 | 6,700 | 21,400 | 4,940 | 5,200 | 5,760 |
| 31..... | 5,030 | ..... | | | ..... | 20,800 | ..... | 7,760 | ..... | 5,480 | 5,480 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1..... | 5,760 | 11,300 | 7,220 | 5,620 | 4,340 | 4,450 | 54,500 | 16,700 | 10,100 | 10,100 | 5,200 | 6,060 |
| 2..... | 5,760 | 8,520 | 7,180 | 4,450 | 4,000 | 5,340 | 62,200 | 13,500 | 8,140 | 9,300 | 4,450 | 6,060 |
| 3..... | 5,480 | 9,700 | 7,130 | 4,690 | 4,450 | 5,340 | 58,900 | 13,000 | 7,760 | 7,760 | 5,200 | 6,060 |
| 4..... | 7,400 | 12,200 | 7,090 | 4,940 | 4,940 | 5,340 | 56,700 | 13,000 | 7,760 | 11,300 | 6,060 | 6,060 |
| 5..... | 10,500 | 16,200 | 7,040 | 4,450 | 5,070 | 5,340 | 54,500 | 12,200 | 7,400 | 13,500 | 5,760 | 5,760 |
| 6..... | 10,900 | 18,700 | 7,040 | 5,070 | 5,200 | 5,480 | 44,500 | 12,200 | 7,400 | 13,900 | 5,760 | 4,220 |
| 7..... | 8,140 | 18,700 | 7,040 | 5,200 | 4,820 | 5,480 | 36,800 | 10,500 | 6,380 | 13,000 | 5,760 | 3,780 |
| 8..... | 8,900 | 18,200 | 6,060 | 5,200 | 5,070 | 5,200 | 36,800 | 8,520 | 7,400 | 11,800 | 5,480 | 5,200 |
| 9..... | 8,140 | 15,800 | 6,870 | 5,200 | 4,570 | 5,760 | 34,100 | 8,900 | 7,400 | 11,800 | 4,220 | 5,760 |
| 10..... | 6,380 | 16,700 | 6,840 | 5,070 | 5,070 | 5,910 | 28,500 | 8,140 | 7,400 | 10,100 | 5,200 | 6,700 |
| 11..... | 8,520 | 14,800 | 6,810 | 4,940 | 5,070 | 6,060 | 25,700 | 8,140 | 7,040 | 7,400 | 5,480 | 6,700 |
| 12..... | 6,060 | 14,400 | 6,770 | 4,690 | 5,200 | 6,380 | 21,900 | 8,900 | 6,700 | 8,520 | 6,700 | 5,760 |
| 13..... | 5,480 | 13,500 | 6,730 | 5,070 | 5,340 | 6,700 | 16,700 | 8,900 | 6,380 | 8,900 | 6,060 | 4,220 |
| 14..... | 6,380 | 15,800 | 6,700 | 5,200 | 5,070 | 7,220 | 13,500 | 8,900 | 5,480 | 9,700 | 6,060 | 5,480 |
| 15..... | 6,380 | 18,700 | 5,760 | 5,200 | 4,820 | 7,760 | 17,700 | 8,900 | 8,140 | 7,760 | 5,480 | 6,060 |
| 16..... | 6,380 | 20,800 | 6,700 | 5,040 | 4,220 | 8,140 | 17,200 | 9,700 | 10,100 | 8,140 | 4,220 | 6,380 |
| 17..... | 6,380 | 23,800 | 6,700 | 4,940 | 4,690 | 9,300 | 13,500 | 11,300 | 21,900 | 8,900 | 5,200 | 6,380 |
| 18..... | 6,060 | 30,800 | 6,700 | 4,940 | 5,340 | 9,700 | 13,500 | 11,800 | 23,800 | 7,400 | 5,760 | 6,060 |
| 19..... | 5,760 | 21,400 | 6,700 | 4,450 | 5,200 | 8,900 | 13,000 | 10,500 | 23,100 | 6,380 | 6,060 | 5,480 |
| 20..... | 4,690 | 20,800 | 6,700 | 4,940 | 5,340 | 9,700 | 13,500 | 9,300 | 21,400 | 7,040 | 6,060 | 4,000 |
| 21..... | 5,480 | 15,800 | 6,700 | 5,200 | 5,200 | 10,900 | 12,200 | 9,300 | 20,300 | 6,700 | 5,760 | 4,940 |
| 22..... | 5,760 | 14,400 | 5,760 | 4,940 | 5,340 | 12,200 | 13,000 | 9,700 | 23,100 | 6,060 | 6,060 | 5,200 |
| 23..... | 5,760 | 12,600 | 6,580 | 5,070 | 4,000 | 18,700 | 13,000 | 11,300 | 24,400 | 6,060 | 4,690 | 5,200 |
| 24..... | 5,200 | 10,500 | 6,540 | 4,820 | 5,340 | 20,800 | 13,000 | 10,100 | 23,800 | 5,760 | 5,480 | 5,200 |
| 25..... | 6,060 | 11,300 | 6,060 | 4,940 | 5,480 | 21,900 | 12,200 | 13,500 | 21,900 | 5,760 | 6,060 | 4,690 |
| 26..... | 5,760 | 10,500 | 4,940 | 4,220 | 5,480 | 23,800 | 11,300 | 13,900 | 16,200 | 4,940 | 6,060 | 4,690 |
| 27..... | 4,940 | 12,600 | 5,620 | 5,340 | 5,200 | 25,100 | 13,900 | 11,800 | 13,000 | 5,480 | 5,760 | 3,560 |
| 28..... | 6,060 | 9,300 | 5,620 | 5,340 | 5,340 | 27,800 | 16,700 | 13,500 | 10,500 | 6,060 | 5,760 | 4,450 |
| 29..... | 6,380 | 9,300 | 5,480 | 4,940 | 5,200 | 30,000 | 18,700 | 15,800 | 10,500 | 6,060 | 6,380 | 4,690 |
| 30..... | 6,700 | 8,140 | 5,620 | 5,070 | ..... | 40,500 | 18,700 | 15,300 | 10,500 | 5,760 | 4,940 | 4,690 |
| 31..... | 8,520 | ..... | 5,620 | 5,070 | ..... | 51,500 | ..... | 13,500 | ..... | 5,200 | 5,760 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 25, 1918, to Feb. 16, 1919, Feb. 26 to Mar. 14, 1919, and Dec. 1, 1919, to Mar. 22, 1920; mean discharge for first two periods and daily discharge for latter period ascertained by comparison with flow of this river at Prairie du Sac plant of Wisconsin Power, Light & Heat Co. as determined by the kilowatt output, and by comparison with flow at Nekoosa, Wis. Indirect method for shifting channel used Apr. 21 to Nov. 30, 1919, and Mar. 23 to Sept. 30, 1920. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Wisconsin River at Muscoda, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 10,300 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 5,030 | 3,620 | 4,500 | 0.437 | 0.50 |
| November | 6,640 | 4,250 | 5,740 | .557 | .62 |
| December | ..... | ..... | 5,710 | .554 | .64 |
| January | ..... | ..... | 6,550 | .636 | .73 |
| February | ..... | ..... | 5,810 | .564 | .59 |
| March | 28,500 | ..... | 14,200 | 1.38 | 1.59 |
| April | 41,500 | 13,000 | 22,100 | 2.15 | 2.40 |
| May | 16,200 | 6,380 | 10,800 | 1.05 | 1.21 |
| June | 21,400 | 6,380 | 11,300 | 1.10 | 1.23 |
| July | 24,400 | 4,450 | 9,170 | .890 | 1.03 |
| August | 14,400 | 5,200 | 8,720 | .847 | .98 |
| September | 6,060 | 4,220 | 5,100 | .495 | .55 |
| The year | 41,500 | ..... | 9,150 | .888 | 12.07 |
| 1919–20. | | | | | |
| October | 10,900 | 4,690 | 6,650 | .646 | .74 |
| November | 30,800 | 8,140 | 15,200 | 1.48 | 1.65 |
| December | 7,220 | 4,940 | 6,460 | .627 | .72 |
| January | 5,620 | 4,220 | 4,980 | .483 | .56 |
| February | 5,480 | 4,000 | 4,980 | .483 | .52 |
| March | 51,500 | 4,450 | 13,400 | 1.30 | 1.50 |
| April | 62,200 | 11,300 | 25,900 | 2.51 | 2.80 |
| May | 16,700 | 8,140 | 11,300 | 1.10 | 1.27 |
| June | 24,400 | 5,480 | 12,800 | 1.24 | 1.38 |
| July | 13,900 | 4,940 | 8,280 | .804 | .93 |
| August | 6,700 | 4,220 | 5,580 | .542 | .62 |
| September | 6,700 | 3,560 | 5,320 | .517 | .58 |
| The year | 62,200 | 3,560 | 10,100 | .981 | 13.27 |

*Days of deficiency in discharge of Wisconsin River at Muscoda, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 2,500 | ..... | ..... | ..... | 1 | ..... | ..... | 1 | 0.05 |
| 2,800 | ..... | ..... | ..... | 4 | ..... | ..... | 4 | .2 |
| 3,100 | ..... | ..... | ..... | 14 | ..... | ..... | 14 | .6 |
| 3,400 | 1 | ..... | ..... | 29 | ..... | ..... | 30 | 1.4 |
| 3,700 | 4 | ..... | 8 | 57 | 2 | 1 | 72 | 3.3 |
| 4,000 | 4 | ..... | 20 | 66 | 3 | 2 | 95 | 4.3 |
| 4,300 | 59 | 5 | 53 | 76 | 12 | 11 | 216 | 9.9 |
| 4,600 | 75 | 9 | 69 | 89 | 25 | 20 | 287 | 13.1 |
| 4,900 | 81 | 26 | 74 | 104 | 45 | 32 | 362 | 16.5 |
| 5,200 | 90 | 43 | 88 | 129 | 90 | 58 | 498 | 22.7 |
| 5,500 | 104 | 71 | 103 | 146 | 107 | 109 | 640 | 29.2 |
| 5,800 | 120 | 83 | 108 | 162 | 135 | 137 | 745 | 34.0 |
| 6,100 | 131 | 104 | 123 | 183 | 156 | 163 | 860 | 39.2 |
| 6,500 | 147 | 119 | 138 | 204 | 184 | 176 | 968 | 44.2 |
| 7,000 | 167 | 147 | 156 | 219 | 225 | 197 | 1,111 | 50.6 |
| 7,500 | 185 | 165 | 181 | 231 | 232 | 215 | 1,209 | 55.2 |
| 8,000 | 202 | 189 | 192 | 240 | 239 | 220 | 1,282 | 58.5 |
| 9,000 | 242 | 224 | 222 | 251 | 256 | 243 | 1,438 | 65.6 |
| 11,000 | 302 | 248 | 268 | 280 | 271 | 270 | 1,639 | 74.8 |
| 14,000 | 339 | 274 | 297 | 305 | 306 | 309 | 1,830 | 83.5 |
| 18,000 | 353 | 311 | 317 | 331 | 328 | 325 | 1,965 | 89.6 |
| 23,000 | 364 | 326 | 339 | 350 | 346 | 342 | 2,067 | 94.3 |
| 33,000 | 365 | 353 | 365 | 360 | 361 | 355 | 2,159 | 98.5 |
| 45,000 | ..... | 361 | ..... | 365 | 365 | 360 | 2,181 | 99.5 |
| 60,000 | ..... | 366 | ..... | ..... | ..... | 365 | 2,191 | 99.95 |
| 80,000 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 8,080 | 11,400 | 9,810 | 8,670 | 9,150 | 10,100 | ..... | ..... |
| Maximum (sec.-ft.) | 23,600 | 53,500 | 31,600 | 39,900 | 41,500 | 62,200 | ..... | ..... |
| Minimum (sec.-ft.) | [a] 3,290 | 4,000 | 3,400 | 2,000 | 3,620 | 3,560 | ..... | ..... |

[a] Approximate.

### TOMAHAWK RIVER NEAR BRADLEY, WIS.

LOCATION.—In sec. 16, T. 36 N., R. 6 E., 2 miles west of Cassion, 4 miles north of Bradley, Oneida County, 4 miles downstream from mouth of Bearskin Creek, which comes in from right, and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1920.

GAGE.—Slope gage fastened to concrete posts on right bank of river, installed September 24, 1919; prior to that date, chain gage fastened to cantilever arm on right bank; both gages at same datum; read by Frank Sutherland.

DISCHARGE MEASUREMENTS.—Made from cable about half a mile below gage.

CHANNEL AND CONTROL.—Bed at gage and a short distance below composed of sand; may shift; bed at cable composed of heavy gravel. Control is formed by rapids about 2,000 feet below gage. When a head of 15 feet is maintained on Rice Lake storage dam, in sections 4 and 9, T. 35 N., R. 6 E., backwater will extend half way up the rapids, and may affect stage-discharge relation. The maximum head maintained during 1919 and 1920 at the reservoir was 14 feet and 9 inches during week ending November 29, 1919, which apparently caused no backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 5.10 feet at 6.10 p. m. April 11 (discharge, 1,270 second feet); minimum stage recorded, 1.76 feet at 6.20 p. m. October 3 and 7.35 a. m. October 4 (discharge, about 211 second-feet).

Maximum stage recorded during year ending September 30, 1920, 6.17 feet about noon March 30 (discharge, 1,770 second-feet); minimum stage recorded, 1.37 feet at 6 a. m. and 6 p. m. August 28 (discharge, 165 second-feet).

1914–1920: Maximum stage recorded, 6.9 feet April 24, 1916 (discharge, 2,200 second-feet); minimum discharge, 144 second-feet November 17, 1915 (by current-meter measurement).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The following reservoirs are maintained upstream from the station, for the purpose of regulating the flow of Wisconsin River:

*Dams and reservoirs on Tomahawk River.*

| Name. | Location of reservoir. | Location of dam. | Area of reservoir. | Drainage area. | Capacity (millions of cubic feet). | |
|---|---|---|---|---|---|---|
| | | | | | Summer. | Winter. |
| | | | *Sq. mi.* | *Sq. mi.* | | |
| Squirrel.... | T. 39 N., R. 5 E..... | Sec. 30, T. 39 N., R. 5 E..... | 3.00 | 17.07 | 152 | 152 |
| Minocqua.. | Tps. 38–40 N., Rs. 6–7 E.... | Sec. 10, T. 39 N., R. 6 E..... | 11.31 | 81.60 | 291 | 651 |
| | | | 14.31 | 98.67 | 443 | 803 |

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve used, poorly defined below 350 second-feet and well defined above. Gage read to hundredths twice daily except during winter, when, in 1919, it was read once a week, and in 1920, it was read only a few times. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records good except for low stages, for which they are fair; winter records poor.

*Discharge measurements of Tomahawk River near Bradley, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Jan. 11[a] | S. B. Soulé | 3.23 | 389 | Dec. 11[a] | S. B. Soulé | 3.32 | 398 |
| Feb. 10[a] | do | 2.64 | 307 | | | | |
| Mar. 6[a] | do | 2.87 | 268 | 1920. | | | |
| May 29 | W. G. Hoyt | 2.42 | 367 | Jan. 15[b] | do | | 551 |
| Sept. 24 | S. B. Soulé | 2.16 | 273 | June 10 | do | 2.22 | 313 |

[a] Complete ice cover at control and measuring section.
[b] Gage inaccessible on account of snow. Measurement made about 5 miles downstream. Released water from Rice Lake reservoir enters between this measuring point and gage.

*Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 218 | 447 | | | | | | 502 | 329 | 304 | 502 | 250 |
| 2 | 218 | 447 | | | | | 700 | 502 | 342 | 270 | 474 | 242 |
| 3 | 211 | 447 | | | | | | 559 | 342 | 260 | 447 | 242 |
| 4 | 218 | 447 | | | | | | 502 | 329 | 355 | 502 | 242 |
| 5 | 226 | 420 | 440 | 385 | 320 | 280 | 650 | 530 | 292 | 530 | 474 | 250 |
| 6 | 242 | 447 | | | | | 681 | 530 | 292 | 713 | 447 | 260 |
| 7 | 250 | 589 | | | | | 713 | 530 | 329 | 713 | 474 | 260 |
| 8 | 260 | 650 | | | | | 780 | 530 | 394 | 713 | 474 | 250 |
| 9 | 281 | 681 | | | | | 850 | 502 | 394 | 713 | 447 | 242 |
| 10 | 292 | 681 | | | | | 1,000 | 474 | 447 | 650 | 420 | 234 |
| 11 | 292 | 681 | | | | | 1,220 | 447 | 474 | 589 | 394 | 234 |
| 12 | 281 | 619 | | | | | 1,120 | 420 | 447 | 530 | 368 | 226 |
| 13 | 270 | 589 | | | | | 1,080 | 394 | 394 | 447 | 355 | 226 |
| 14 | 250 | 559 | | | | | 1,170 | 394 | 342 | 420 | 355 | 234 |
| 15 | 250 | 530 | 425 | 375 | 320 | 310 | 1,120 | 394 | 394 | 394 | 342 | 234 |
| 16 | 242 | 502 | | | | | 1,040 | 447 | 559 | 394 | 342 | 234 |
| 17 | 242 | 502 | | | | | 961 | 502 | 589 | 355 | 342 | 234 |
| 18 | 234 | 530 | | | | | 923 | 559 | 559 | 329 | 342 | 234 |
| 19 | 234 | 502 | | | | | 815 | 530 | 530 | 304 | 316 | 234 |
| 20 | 260 | 502 | | | | | 780 | 502 | 474 | 281 | 304 | 234 |
| 21 | 292 | 502 | | | | | 746 | 447 | 420 | 270 | 394 | 270 |
| 22 | 304 | 474 | | | | | 746 | 420 | 368 | 260 | 447 | 292 |
| 23 | 316 | 420 | | | | | 746 | 447 | 394 | 260 | 394 | 281 |
| 24 | 329 | | | | | 575 | 713 | 502 | 474 | 250 | 368 | 281 |
| 25 | 316 | | | | 320 | | 681 | 502 | 559 | 281 | 329 | 281 |
| 26 | 316 | 435 | 400 | 345 | | | 681 | 474 | 559 | 474 | 304 | 270 |
| 27 | 329 | | | | | | 619 | 420 | 502 | 559 | 292 | 270 |
| 28 | 420 | | | | | 700 | 559 | 368 | 447 | 559 | 270 | 270 |
| 29 | 447 | | | | ..... | | 530 | 342 | 420 | 559 | 270 | 368 |
| 30 | 474 | | | | ..... | | 502 | 329 | 355 | 502 | 260 | 420 |
| 31 | 474 | ..... | | | ..... | | ..... | 329 | ..... | 502 | 260 | ..... |

*Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 420 | 589 | 500 | | | | 1,530 | 530 | 270 | 681 | 211 | 260 |
| 2 | 447 | 619 | 500 | | | | 1,420 | 502 | 270 | 681 | 204 | 270 |
| 3 | 447 | 619 | 500 | | | | 1,330 | 474 | 260 | 650 | 198 | 260 |
| 4 | 447 | 650 | 500 | | | | 1,250 | 447 | 250 | 589 | 192 | 260 |
| 5 | 447 | 619 | 475 | | | | 1,180 | 420 | 242 | 559 | 192 | 260 |
| 6 | 447 | 589 | 445 | | | | 1,100 | 420 | 242 | 502 | 192 | 250 |
| 7 | 447 | 589 | 445 | | | | 1,020 | 394 | 260 | 502 | 192 | 250 |
| 8 | 420 | 559 | 445 | 375 | 340 | 325 | 940 | 394 | 281 | 474 | 204 | 250 |
| 9 | 420 | 687 | 420 | | | | 860 | 368 | 292 | 447 | 204 | 250 |
| 10 | 447 | 815 | | | | | 780 | 368 | 292 | 420 | 198 | 242 |
| 11 | 394 | 815 | | | | | 713 | 355 | 368 | 394 | 198 | 270 |
| 12 | 394 | 928 | | | | | 687 | 342 | 474 | 355 | 226 | 329 |
| 13 | 394 | 1,040 | | | | | 660 | 329 | 502 | 342 | 234 | 329 |
| 14 | 368 | 1,040 | | | | | 634 | 316 | 559 | 316 | 226 | 316 |
| 15 | 394 | 1,000 | | | | | 608 | 316 | 589 | 329 | 211 | 304 |
| 16 | 368 | 925 | | | | 350 | 581 | 304 | 650 | 316 | 204 | 304 |
| 17 | 368 | 815 | | | | 375 | 555 | 292 | 713 | 316 | 192 | 292 |
| 18 | 368 | 715 | | | | 420 | 528 | 304 | 713 | 304 | 186 | 281 |
| 19 | 394 | 650 | | | | 440 | 502 | 329 | 681 | 292 | 186 | 270 |
| 20 | 394 | 620 | 400 | | | 460 | 502 | 368 | 650 | 281 | 180 | 270 |
| 21 | 394 | 620 | | | | 475 | 530 | 394 | 589 | 270 | 180 | 270 |
| 22 | 394 | 620 | | | 325 | 560 | 530 | 394 | 530 | 250 | 180 | 270 |
| 23 | 420 | 620 | | 350 | | 650 | 519 | 474 | 474 | 234 | 175 | 270 |
| 24 | 420 | 620 | | | | 750 | 681 | 502 | 474 | 250 | 175 | 270 |
| 25 | 447 | 590 | | | | 850 | 681 | 447 | 447 | 270 | 170 | 270 |
| 26 | 447 | 590 | | | | 1,050 | 681 | 420 | 420 | 270 | 170 | 260 |
| 27 | 447 | 560 | | | | 1,220 | 650 | 394 | 420 | 250 | 170 | 250 |
| 28 | 447 | 560 | | | | 1,400 | 619 | 355 | 559 | 242 | 165 | 250 |
| 29 | 447 | 560 | | | | 1,580 | 589 | 329 | 681 | 234 | 175 | 250 |
| 30 | 474 | 530 | | | ..... | 1,770 | 559 | 316 | 681 | 226 | 218 | 250 |
| 31 | 559 | ..... | | | ..... | 1,650 | ..... | 292 | ..... | 218 | 260 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 24, 1918, to Mar. 26, 1919, and Nov. 14, 1919, to Apr. 10, 1920; discharge ascertained by means of occasional gage reading, discharge measurements, observer's notes, and weather records. Gage not read, Mar. 27 to Apr. 4, 1919; discharge estimated. Gage not read Nov. 9, 12, 1919, and Apr. 12–18, 1920; discharge interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Tomahawk River near Bradley, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 422 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 474 | 211 | 290 | 0.687 | 0.79 |
| November | 681 | ..... | 507 | 1.20 | 1.34 |
| December | ..... | ..... | 421 | .998 | 1.15 |
| January | ..... | ..... | 368 | .872 | 1.01 |
| February | ..... | ..... | 320 | .758 | .79 |
| March | ..... | ..... | 415 | .983 | 1.13 |
| April | 1,220 | 502 | 808 | 1.91 | 2.13 |
| May | 559 | 329 | 462 | 1.09 | 1.26 |
| June | 589 | 292 | 425 | 1.01 | 1.13 |
| July | 713 | 250 | 443 | 1.05 | 1.21 |
| August | 502 | 260 | 378 | .896 | 1.03 |
| September | 420 | 226 | 260 | .616 | .69 |
| The year | 1,220 | ..... | 425 | 1.01 | 13.66 |
| 1919–20. | | | | | |
| October | 559 | 368 | 423 | 1.00 | 1.15 |
| November | 1,040 | 530 | 692 | 1.64 | 1.83 |
| December | 500 | ..... | 420 | .995 | 1.15 |
| January | ..... | ..... | 362 | .858 | .99 |
| February | ..... | ..... | 333 | .789 | .85 |
| March | 1,770 | ..... | 609 | 1.44 | 1.66 |
| April | 1,530 | 502 | 781 | 1.85 | 2.06 |
| May | 530 | 292 | 384 | .910 | 1.05 |
| June | 713 | 242 | 461 | 1.09 | 1.22 |
| July | 681 | 218 | 370 | .877 | 1.01 |
| August | 260 | 165 | 196 | .464 | .53 |
| September | 329 | 242 | 271 | .642 | .72 |
| The year | 1,770 | 165 | 441 | 1.05 | 14.22 |

*Days of deficiency in discharge of Tomahawk River near Bradley, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 160 | ..... | ..... | ..... | ..... | ..... | 7 | 7 | 0.3 |
| 180 | ..... | ..... | ..... | ..... | ..... | 12 | 12 | .5 |
| 200 | ..... | ..... | ..... | 2 | ..... | 20 | 22 | 1.0 |
| 220 | ..... | ..... | ..... | 15 | 4 | 28 | 47 | 2.1 |
| 240 | ..... | ..... | 5 | 27 | 18 | 34 | 84 | 3.8 |
| 260 | ..... | ..... | 19 | 50 | 41 | 50 | 160 | 7.3 |
| 280 | 8 | ..... | 34 | 73 | 60 | 72 | 247 | 11.3 |
| 300 | 24 | 1 | 51 | 91 | 74 | 81 | 322 | 14.7 |
| 320 | 84 | 6 | 71 | 126 | 121 | 93 | 501 | 22.9 |
| 340 | 120 | 14 | 106 | 142 | 130 | 128 | 640 | 29.2 |
| 360 | 147 | 35 | 141 | 165 | 154 | 165 | 807 | 36.8 |
| 380 | 180 | 75 | 159 | 185 | 169 | 189 | 957 | 43.7 |
| 400 | 202 | 86 | 179 | 213 | 203 | 203 | 1,086 | 49.5 |
| 420 | 220 | 95 | 187 | 238 | 214 | 225 | 1,179 | 53.8 |
| 440 | 230 | 117 | 196 | 259 | 241 | 238 | 1,281 | 58.4 |
| 460 | 241 | 137 | 208 | 283 | 260 | 258 | 1,387 | 62.9 |
| 480 | 248 | 144 | 226 | 288 | 272 | 268 | 1,446 | 66.0 |
| 500 | 251 | 152 | 237 | 291 | 272 | 268 | 1,471 | 67.1 |
| 550 | 264 | 178 | 272 | 322 | 303 | 286 | 1,625 | 74.1 |
| 600 | 292 | 195 | 300 | 331 | 323 | 307 | 1,748 | 79.8 |
| 700 | 328 | 262 | 341 | 345 | 347 | 336 | 1,959 | 89.4 |
| 800 | 347 | 313 | 356 | 351 | 354 | 342 | 2,063 | 94.1 |
| 1,000 | 365 | 332 | 365 | 360 | 359 | 350 | 2,131 | 97.2 |
| 1,400 | ..... | 346 | ..... | 365 | 365 | 360 | 2,166 | 98.8 |
| 1,600 | ..... | 350 | ..... | ..... | ..... | 364 | 2,174 | 99.2 |
| 2,000 | ..... | 361 | ..... | ..... | ..... | 366 | 2,187 | 99.8 |
| 2,500 | ..... | 366 | ..... | ..... | ..... | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 452 | 635 | 452 | 408 | 425 | 441 | ..... | ..... |
| Maximum (sec.-ft.) | 886 | 2,200 | 923 | 1,120 | 1,220 | 1,770 | ..... | ..... |
| Minimum (sec.-ft.) | 263 | 298 | 232 | 195 | 211 | 165 | ..... | ..... |

### PRAIRIE RIVER NEAR MERRILL, WIS.

LOCATION.—On line between secs. 20 and 29, T. 32 N., R. 7 E., at highway bridge 4½ miles northeast of Merrill, Lincoln County, and 5½ miles above mouth of river. Haymeadow Creek enters from left 5 miles above station.

DRAINAGE AREA.—164 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 17, 1914, to September 30, 1920.

GAGE.—Chain gage attached to upstream side of bridge; read by Mrs. Meta Krause.

DISCHARGE MEASUREMENTS.—Made from highway bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; clean and free from vegetation. Right bank high and not subject to overflow; left bank may be overflowed at extreme high stages; both banks wooded. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.7 feet April 11 (discharge, 1,220 second-feet); minimum discharge, estimated 85 second-feet January 31 to February 6, and February 26–28 (stage-discharge relation affected by ice).

Maximum stage recorded during year ending September 30, 1920, 5.65 feet at 3 p. m. March 28 (discharge, 1,900 second-feet); minimum stage recorded, 1.50 feet July 27 (discharge, 73 second-feet).

1914–1920: Maximum stage recorded, 6.1 feet April 22, 1916 (discharge, 2,290 second-feet); minimum discharge, 72 second-feet January 4, 1915, by current-meter measurement.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 103 and 2,200 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods December 21, 1918, to March 9, 1919, and November 27, 1919, to March 25, 1920, during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table the daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records, and except for December 3, 1918, and September 19, 1920, for which it was estimated on account of error in gage reading. Records good.

*Discharge measurements of Prairie River near Merrill, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan. 10[a] | S. B. Soulé | 2.20 | 103 | Jan. 14[a] | S. B. Soulé | 2.00 | 104 |
| Feb. 8[a] | do | 1.81 | 89 | Feb. 11[a] | do | 1.92 | 106 |
| Mar. 5[a] | do | 1.86 | 97 | June 10 | do | 1.94 | 129 |
| June 1 | W. G. Hoyt | 2.00 | 132 | | | | |
| Dec. 10[a] | S. B. Soulé | 2.34 | 115 | | | | |

[a] Incomplete ice cover at control section.

*Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 110 | 212 | 133 | 115 | 85 | 90 | 421 | 278 | 128 | 244 | 330 | 115 |
| 2 | 106 | 212 | 133 | 115 | 85 | 90 | 348 | 278 | 137 | 212 | 244 | 106 |
| 3 | 110 | 184 | 125 | 115 | 85 | 90 | 348 | 278 | 137 | 198 | 198 | 103 |
| 4 | 115 | 184 | 148 | 110 | 85 | 95 | 348 | 244 | 148 | 184 | 184 | 101 |
| 5 | 115 | 184 | 159 | 110 | 85 | 95 | 348 | 244 | 148 | 172 | 228 | 106 |
| 6 | 115 | 172 | 137 | 110 | 85 | 95 | 384 | 244 | 159 | 184 | 296 | 101 |
| 7 | 118 | 172 | 133 | 105 | 90 | 95 | 458 | 244 | 184 | 184 | 212 | 101 |
| 8 | 122 | 228 | 128 | 105 | 90 | 95 | 963 | 244 | 159 | 159 | 296 | 103 |
| 9 | 128 | 244 | 128 | 105 | 90 | 95 | 1,010 | 212 | 184 | 148 | 244 | 106 |
| 10 | 159 | 212 | 137 | 105 | 90 | 97 | 1,060 | 184 | 198 | 137 | 159 | 103 |
| 11 | 172 | 184 | 133 | 105 | 90 | 101 | 1,220 | 172 | 244 | 128 | 159 | 106 |
| 12 | 184 | 184 | 133 | 105 | 90 | 103 | 1,220 | 172 | 278 | 128 | 137 | 101 |
| 13 | 159 | 184 | 133 | 110 | 90 | 122 | 781 | 159 | 244 | 118 | 133 | 103 |
| 14 | 137 | 159 | 133 | 110 | 90 | 122 | 696 | 148 | 198 | 118 | 148 | 101 |
| 15 | 133 | 137 | 133 | 110 | 90 | 133 | 614 | 172 | 198 | 122 | 148 | 101 |
| 16 | 128 | 159 | 133 | 110 | 90 | 137 | 574 | 137 | 278 | 115 | 137 | 103 |
| 17 | 118 | 172 | 128 | 110 | 90 | 278 | 535 | 137 | 278 | 103 | 133 | 97 |
| 18 | 115 | 212 | 128 | 110 | 90 | 313 | 496 | 137 | 296 | 103 | 128 | 101 |
| 19 | 115 | 228 | 133 | 110 | 90 | 366 | 458 | 137 | 278 | 103 | 128 | 103 |
| 20 | 110 | 212 | 128 | 110 | 90 | 458 | 384 | 137 | 366 | 101 | 122 | 103 |
| 21 | 110 | 184 | 125 | 105 | 90 | 535 | 348 | 137 | 348 | 101 | 122 | 110 |
| 22 | 118 | 148 | 125 | 105 | 90 | 535 | 366 | 137 | 261 | 103 | 118 | 115 |
| 23 | 128 | 148 | 125 | 105 | 90 | 614 | 348 | 137 | 184 | 97 | 118 | 118 |
| 24 | 128 | 137 | 125 | 105 | 90 | 614 | 313 | 159 | 278 | 97 | 106 | 115 |
| 25 | 118 | 148 | 120 | 105 | 90 | 614 | 278 | 159 | 366 | 101 | 106 | 118 |
| 26 | 122 | 148 | 120 | 100 | 85 | 655 | 244 | 172 | 963 | 366 | 106 | 115 |
| 27 | 118 | 148 | 120 | 90 | 85 | 696 | 212 | 137 | 738 | 458 | 106 | 106 |
| 28 | 184 | 137 | 120 | 90 | 85 | 696 | 212 | 133 | 574 | 440 | 103 | 115 |
| 29 | 212 | 128 | 115 | 90 | ..... | 614 | 198 | 122 | 535 | 384 | 103 | 110 |
| 30 | 212 | 148 | 115 | 90 | ..... | 535 | 198 | 118 | 278 | 296 | 110 | 110 |
| 31 | 212 | ..... | 115 | 85 | ..... | 458 | ..... | 118 | ..... | 366 | 110 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 159 | 574 | 160 | 85 | 120 | 105 | 1,010 | 228 | 137 | 458 | 91 | 103 |
| 2 | 159 | 535 | 160 | 90 | 120 | 105 | 870 | 198 | 131 | 348 | 89 | 101 |
| 3 | 212 | 535 | 150 | 100 | 120 | 105 | 781 | 184 | 131 | 313 | 91 | 98 |
| 4 | 261 | 496 | 150 | 105 | 120 | 105 | 655 | 159 | 122 | 261 | 89 | 93 |
| 5 | 244 | 496 | 135 | 105 | 120 | 105 | 614 | 159 | 116 | 212 | 89 | 91 |
| 6 | 212 | 458 | 130 | 105 | 120 | 105 | 496 | 148 | 114 | 184 | 89 | 91 |
| 7 | 212 | 384 | 130 | 105 | 115 | 105 | 366 | 148 | 122 | 184 | 118 | 91 |
| 8 | 184 | 330 | 120 | 105 | 110 | 110 | 313 | 148 | 148 | 184 | 118 | 89 |
| 9 | 137 | 348 | 120 | 105 | 110 | 110 | 296 | 184 | 137 | 172 | 148 | 91 |
| 10 | 118 | 614 | 115 | 105 | 105 | 110 | 278 | 184 | 131 | 159 | 133 | 91 |
| 11 | 118 | 825 | 120 | 105 | 105 | 110 | 228 | 198 | 278 | 137 | 115 | 93 |
| 12 | 115 | 870 | 125 | 105 | 105 | 115 | 198 | 228 | 313 | 137 | 109 | 101 |
| 13 | 122 | 614 | 125 | 105 | 105 | 115 | 198 | 148 | 781 | 129 | 103 | 103 |
| 14 | 137 | 614 | 130 | 105 | 105 | 115 | 212 | 137 | 574 | 122 | 103 | 112 |
| 15 | 133 | 535 | 125 | 105 | 105 | 120 | 228 | 131 | 535 | 118 | 101 | 159 |
| 16 | 133 | 384 | 120 | 105 | 105 | 130 | 261 | 198 | 916 | 109 | 98 | 212 |
| 17 | 118 | 313 | 115 | 110 | 105 | 135 | 278 | 212 | 1,010 | 106 | 98 | 172 |
| 18 | 115 | 313 | 115 | 110 | 105 | 140 | 198 | 228 | 825 | 103 | 91 | 137 |
| 19 | 128 | 278 | 110 | 110 | 105 | 160 | 184 | 261 | 614 | 101 | 89 | 212 |
| 20 | 137 | 278 | 110 | 110 | 105 | 160 | 172 | 313 | 458 | 101 | 89 | 137 |
| 21 | 172 | 212 | 100 | 115 | 105 | 165 | 172 | 402 | 384 | 101 | 91 | 133 |
| 22 | 137 | 212 | 95 | 120 | 105 | 185 | 172 | 440 | 296 | 96 | 91 | 126 |
| 23 | 122 | 212 | 100 | 120 | 105 | 210 | 198 | 402 | 244 | 96 | 89 | 118 |
| 24 | 137 | 184 | 100 | 120 | 105 | 420 | 496 | 574 | 212 | 103 | 89 | 115 |
| 25 | 172 | 184 | 105 | 120 | 105 | 1,420 | 402 | 496 | 184 | 101 | 89 | 112 |
| 26 | 244 | 172 | 110 | 120 | 105 | 1,860 | 384 | 384 | 172 | 101 | 89 | 101 |
| 27 | 261 | 170 | 110 | 120 | 105 | 1,560 | 330 | 296 | 184 | 73 | 87 | 101 |
| 28 | 244 | 170 | 110 | 120 | 105 | 1,860 | 296 | 228 | 212 | 87 | 89 | 99 |
| 29 | 184 | 170 | 110 | 120 | 105 | 1,860 | 278 | 184 | 535 | 91 | 89 | 98 |
| 30 | 184 | 170 | 105 | 120 | ..... | 1,860 | 244 | 159 | 535 | 91 | 101 | 98 |
| 31 | 574 | ..... | 95 | 120 | ..... | 1,160 | ..... | 159 | ..... | 89 | 106 | ..... |

*Monthly discharge of Prairie River near Merrill, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 164 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 212 | 106 | 136 | 0.829 | 0.96 |
| November | 244 | 128 | 177 | 1.08 | 1.20 |
| December | 159 | 115 | 129 | .787 | .91 |
| January | 115 | 85 | 105 | .640 | .74 |
| February | 90 | 85 | 88.4 | .539 | .56 |
| March | 696 | 90 | 311 | 1.90 | 2.19 |
| April | 1,220 | 198 | 513 | 3.13 | 3.49 |
| May | 278 | 118 | 177 | 1.08 | 1.24 |
| June | 963 | 128 | 292 | 1.78 | 1.99 |
| July | 458 | 97 | 186 | 1.13 | 1.30 |
| August | 330 | 103 | 160 | .976 | 1.13 |
| September | 118 | 97 | 107 | .652 | .73 |
| The year | 1,220 | 85 | 199 | 1.21 | 16.44 |
| 1919–20. | | | | | |
| October | 574 | 115 | 180 | 1.10 | 1.27 |
| November | 870 | 170 | 388 | 2.37 | 2.64 |
| December | 160 | 95 | 120 | .732 | .84 |
| January | 120 | 85 | 110 | .671 | .77 |
| February | 120 | 105 | 109 | .665 | .72 |
| March | 1,860 | 105 | 481 | 2.93 | 3.38 |
| April | 1,010 | 172 | 360 | 2.20 | 2.46 |
| May | 574 | 131 | 243 | 1.48 | 1.71 |
| June | 1,010 | 114 | 352 | 2.15 | 2.40 |
| July | 458 | 73 | 151 | .921 | 1.06 |
| August | 148 | 87 | 98.6 | .601 | .69 |
| September | 212 | 89 | 116 | .707 | .79 |
| The year | 1,860 | 73 | 225 | 1.37 | 18.73 |

*Days of deficiency in discharge of Prairie River near Merrill, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1915. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time |
| 70 | 0 | 0 | ..... | 0 | ..... | ..... | 0 | 0.0 |
| 75 | 11 | 4 | ..... | 7 | ..... | 0 | 22 | 1.0 |
| 80 | 32 | 15 | 0 | 51 | 0 | 1 | 99 | 4.5 |
| 85 | 43 | 43 | 3 | 73 | 10 | 1 | 173 | 7.9 |
| 90 | 61 | 53 | 28 | 81 | 36 | 18 | 277 | 12.6 |
| 95 | 65 | 58 | 70 | 98 | 42 | 34 | 367 | 16.7 |
| 100 | 89 | 66 | 92 | 109 | 47 | 43 | 446 | 20.3 |
| 107 | 132 | 101 | 122 | 134 | 93 | 108 | 690 | 31.5 |
| 115 | 151 | 113 | 139 | 159 | 130 | 136 | 828 | 37.8 |
| 125 | 195 | 155 | 161 | 188 | 162 | 175 | 1,036 | 47.3 |
| 135 | 215 | 171 | 175 | 201 | 190 | 193 | 1,145 | 52.2 |
| 145 | 231 | 186 | 184 | 234 | 211 | 208 | 1,254 | 57.2 |
| 155 | 238 | 191 | 191 | 245 | 224 | 216 | 1,305 | 59.5 |
| 165 | 251 | 212 | 222 | 265 | 237 | 228 | 1,415 | 64.6 |
| 180 | 258 | 216 | 229 | 270 | 246 | 242 | 1,461 | 66.7 |
| 195 | 273 | 227 | 259 | 277 | 263 | 258 | 1,557 | 71.0 |
| 210 | 274 | 230 | 266 | 279 | 270 | 265 | 1,584 | 72.3 |
| 230 | 284 | 238 | 286 | 291 | 286 | 285 | 1,670 | 76.2 |
| 280 | 303 | 259 | 305 | 309 | 310 | 301 | 1,787 | 81.5 |
| 350 | 328 | 291 | 315 | 330 | 324 | 316 | 1,904 | 86.9 |
| 550 | 355 | 321 | 344 | 352 | 346 | 340 | 2,058 | 93.8 |
| 800 | 365 | 349 | 359 | 357 | 359 | 352 | 2,141 | 97.7 |
| 1,200 | ..... | 362 | 365 | 363 | 363 | 360 | 2,178 | 99.4 |
| 1,600 | ..... | 363 | ..... | 365 | 365 | 362 | 2,185 | 99.7 |
| 2,300 | ..... | 366 | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 177 | 261 | 200 | 185 | 199 | 225 | ..... | ..... |
| Maximum (sec.-ft.) | 738 | 2,290 | 870 | 1,420 | 1,220 | 1,860 | ..... | ..... |
| Minimum (sec.-ft.) | *a* 70 | 73 | 80 | 75 | 85 | 89 | ..... | ..... |

*a* Approximate.

### EAU CLAIRE RIVER AT KELLY, WIS.

LOCATION.—In sec. 13, T. 28 N., R. 8 E., at highway bridge three-quarters of a mile northeast of Kelly, Marathon County, 1 mile above mouth of Big Sandy Creek, which enters from right, and 4½ miles above mouth of river.

DRAINAGE AREA.—326 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1920.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by William Woolsey and Merle Rossmiller.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Gage is in the rapids which form control. Banks medium high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.45 feet at 8 a. m. June 26 (discharge, 2,500 second-feet); minimum discharge, 63 second-feet, by current-meter measurement March 4.

Maximum stage recorded during year ending September 30, 1920, 6.45 feet at 8.30 a. m. March 26 (discharge, 5,020 second-feet); minimum discharge, estimated 55 second-feet January 1, 2, 4, and 5, and March 6–9 (stage-discharge relation affected by ice.)

1914–1920: Maximum stage recorded, 6.45 feet March 26, 1920 (discharge, 5,020 second-feet); minimum discharge, estimated 30 second-feet December 6, 1917 (stage-discharge relation affected by ice).

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 71 and 3,150 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records, and except for days when gage was not read for which it was interpolated. Open-water records good; winter records fair.

*Discharge measurements of Eau Claire River at Kelly, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Dis. charge. | Date. | Made by— | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Jan 9 [a] | S. B. Soulé | 1.29 | 100 | Jan. 13 [b] | S. B. Soulé | 2.22 | 102 |
| Feb. 7 [a] | do | 1.28 | 64 | Feb. 12 [b] | do | 2.22 | 98 |
| Mar. 4 [b] | do | 1.56 | 63 | June 9 | do | 1.32 | 221 |
| June. 2 | W. G. Hoyt | 1.70 | 346 | | | | |
| Dec. 9 [a] | S. B. Soulé | 2.62 | 180 | | | | |

[a] Incomplete ice cover at control; complete ice cover at measuring section.
[b] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 93 | 213 | 112 | 95 | 80 | 70 | 499 | 300 | 248 | 261 | 862 | 109 |
| 2 | 89 | 213 | 119 | 90 | 80 | 70 | 471 | 365 | 340 | 230 | 528 | 109 |
| 3 | 93 | 213 | 116 | 90 | 75 | 65 | 471 | 340 | 365 | 210 | 416 | 102 |
| 4 | 94 | 213 | 116 | 85 | 75 | 65 | 499 | 340 | 300 | 216 | 340 | 100 |
| 5 | 93 | 199 | 114 | 85 | 70 | 65 | 499 | 340 | 320 | 213 | 499 | 116 |
| 6 | 93 | 177 | 109 | 85 | 65 | 70 | 650 | 284 | 300 | 196 | 416 | 116 |
| 7 | 93 | 171 | 119 | 90 | 65 | 70 | 800 | 340 | 284 | 185 | 320 | 116 |
| 8 | 93 | 179 | 124 | 95 | 70 | 75 | 1,640 | 390 | 320 | 177 | 261 | 106 |
| 9 | 102 | 185 | 129 | 100 | 70 | 80 | 1,640 | 340 | 390 | 177 | 221 | 104 |
| 10 | 109 | 182 | 129 | 100 | 70 | 80 | 1,640 | 320 | 320 | 139 | 196 | 102 |
| 11 | 116 | 179 | 129 | 100 | 75 | 80 | 1,640 | 270 | 499 | 139 | 168 | 100 |
| 12 | 116 | 168 | 124 | 105 | 80 | 85 | 1,370 | 221 | 647 | 147 | 160 | 100 |
| 13 | 110 | 155 | 119 | 105 | 80 | 85 | 1,120 | 207 | 557 | 134 | 160 | 94 |
| 14 | 104 | 142 | 119 | 105 | 85 | 85 | 862 | 196 | 365 | 142 | 160 | 94 |
| 15 | 98 | 152 | 126 | 105 | 85 | 85 | 738 | 207 | 340 | 160 | 171 | 96 |
| 16 | 94 | 171 | 132 | 105 | 85 | 240 | 587 | 221 | 340 | 155 | 155 | 94 |
| 17 | 94 | 185 | 142 | 110 | 80 | 500 | 557 | 238 | 390 | 155 | 142 | 94 |
| 18 | 93 | 199 | 155 | 110 | 80 | 925 | 528 | 231 | 340 | 122 | 134 | 94 |
| 19 | 94 | 244 | 158 | 115 | 80 | 1,290 | 499 | 224 | 340 | 109 | 134 | 94 |
| 20 | 94 | 252 | 160 | 115 | 80 | 1,640 | 499 | 213 | 443 | 109 | 134 | 94 |
| 21 | 94 | 247 | 166 | 115 | 75 | 1,940 | 499 | 207 | 617 | 114 | 196 | 109 |
| 22 | 93 | 227 | 155 | 110 | 75 | 1,740 | 443 | 193 | 677 | 102 | 224 | 132 |
| 23 | 93 | 193 | 150 | 110 | 70 | 1,600 | 390 | 179 | 340 | 100 | 188 | 132 |
| 24 | 98 | 180 | 140 | 105 | 70 | 1,460 | 340 | 171 | 990 | 100 | 155 | 119 |
| 25 | 104 | 168 | 130 | 105 | 70 | 1,370 | 320 | 168 | 2,140 | 114 | 139 | 116 |
| 26 | 100 | 124 | 130 | 100 | 70 | 1,370 | 300 | 166 | 2,450 | 300 | 124 | 109 |
| 27 | 134 | 104 | 125 | 95 | 70 | 990 | 278 | 160 | 1,640 | 499 | 119 | 106 |
| 28 | 168 | 106 | 120 | 90 | 70 | 990 | 255 | 158 | 708 | 677 | 109 | 124 |
| 29 | 224 | 104 | 115 | 90 | ..... | 800 | 250 | 155 | 557 | 557 | 104 | 134 |
| 30 | 221 | 106 | 110 | 85 | ..... | 694 | 238 | 160 | 300 | 677 | 109 | 232 |
| 31 | 216 | ..... | 105 | 85 | ..... | 587 | ..... | 155 | ..... | 1,060 | 109 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 226 | 1,940 | 165 | 55 | 115 | 70 | 1,290 | 284 | 171 | 471 | 89 | 106 |
| 2 | 232 | 1,740 | 160 | 55 | 120 | 70 | 1,210 | 267 | 160 | 340 | 89 | 96 |
| 3 | 300 | 1,130 | 160 | 60 | 115 | 65 | 1,130 | 250 | 158 | 267 | 89 | 94 |
| 4 | 284 | 862 | 160 | 55 | 105 | 65 | 994 | 235 | 150 | 252 | 89 | 89 |
| 5 | 252 | 862 | 165 | 55 | 100 | 60 | 858 | 221 | 150 | 227 | 89 | 89 |
| 6 | 244 | 677 | 170 | 60 | 100 | 55 | 722 | 213 | 145 | 213 | 93 | 89 |
| 7 | 226 | 617 | 175 | 75 | 105 | 55 | 587 | 204 | 150 | 216 | 94 | 89 |
| 8 | 207 | 557 | 175 | 85 | 105 | 55 | 499 | 196 | 188 | 213 | 99 | 85 |
| 9 | 204 | 499 | 180 | 90 | 105 | 55 | 390 | 188 | 216 | 204 | 104 | 104 |
| 10 | 196 | 1,460 | 150 | 100 | 110 | 65 | 390 | 202 | 166 | 193 | 100 | 102 |
| 11 | 196 | 2,240 | 150 | 100 | 105 | 70 | 390 | 320 | 267 | 177 | 100 | 109 |
| 12 | 188 | 2,040 | 145 | 100 | 100 | 75 | 365 | 390 | 617 | 158 | 94 | 124 |
| 13 | 177 | 1,290 | 115 | 100 | 100 | 80 | 340 | 300 | 925 | 150 | 93 | 139 |
| 14 | 171 | 1,130 | 115 | 100 | 95 | 85 | 320 | 264 | 862 | 142 | 89 | 119 |
| 15 | 171 | 990 | 115 | 105 | 95 | 95 | 300 | 235 | 677 | 139 | 89 | 142 |
| 16 | 171 | 860 | 100 | 105 | 95 | 100 | 300 | 224 | 1,060 | 129 | 89 | 300 |
| 17 | 158 | 710 | 95 | 100 | 95 | 110 | 284 | 210 | 1,640 | 126 | 87 | 238 |
| 18 | 155 | 585 | 85 | 95 | 95 | 130 | 267 | 207 | 1,740 | 124 | 84 | 224 |
| 19 | 160 | 500 | 85 | 95 | 95 | 170 | 267 | 224 | 1,060 | 116 | 82 | 168 |
| 20 | 185 | 415 | 80 | 90 | 90 | 210 | 264 | 261 | 617 | 116 | 82 | 160 |
| 21 | 188 | 365 | 80 | 95 | 85 | 245 | 264 | 267 | 443 | 114 | 82 | 158 |
| 22 | 207 | 320 | 75 | 95 | 85 | 300 | 284 | 261 | 340 | 106 | 82 | 155 |
| 23 | 210 | 285 | 75 | 65 | 80 | 470 | 677 | 320 | 365 | 104 | 82 | 145 |
| 24 | 204 | 250 | 80 | 100 | 80 | 1,130 | 738 | 499 | 320 | 104 | 82 | 134 |
| 25 | 300 | 240 | 80 | 100 | 85 | 3,270 | 647 | 471 | 300 | 109 | 82 | 124 |
| 26 | 647 | 215 | 75 | 100 | 80 | 4,820 | 528 | 365 | 250 | 109 | 78 | 124 |
| 27 | 587 | 200 | 75 | 105 | 80 | 3,910 | 443 | 300 | 261 | 109 | 78 | 116 |
| 28 | 471 | 195 | 70 | 115 | 70 | 2,560 | 390 | 252 | 284 | 104 | 78 | 109 |
| 29 | 390 | 180 | 70 | 120 | 70 | 2,670 | 340 | 226 | 340 | 100 | 109 | 104 |
| 30 | 471 | 170 | 70 | 115 | ..... | 2,240 | 300 | 196 | 499 | 94 | 114 | 104 |
| 31 | 1,740 | ..... | 70 | 115 | ..... | 1,550 | ..... | 182 | ..... | 94 | 116 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 22, 1918, to Mar. 18, 1919, and Nov. 14, 1919, to Mar. 25, 1920. Gage not read on Sundays beginning Oct. 6, 1918, up to and including June 1, 1919, nor during period Apr. 4-6, 1920, nor on Aug. 8, 1920; discharge interpolated.

*Monthly discharge of Eau Claire River at Kelly, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 326 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 224 | 89 | 113 | 0.347 | 0.40 |
| November | 252 | 104 | 178 | .546 | .61 |
| December | 166 | 105 | 129 | .396 | .46 |
| January | 115 | 85 | 99.4 | .305 | .35 |
| February | 85 | 65 | 75.0 | .230 | .24 |
| March | 1,940 | 65 | 621 | 1.90 | 2.19 |
| April | 1,640 | 238 | 684 | 2.10 | 2.34 |
| May | 390 | 155 | 241 | .739 | .85 |
| June | 2,450 | 248 | 596 | 1.83 | 2.04 |
| July | 1,060 | 100 | 248 | .761 | .88 |
| August | 862 | 104 | 231 | .709 | .82 |
| September | 232 | 94 | 112 | .344 | .38 |
| The year | 2,450 | 65 | 278 | .853 | 11.56 |
| 1919–20. | | | | | |
| October | 1,740 | 155 | 307 | .942 | 1.09 |
| November | 2,240 | 170 | 784 | 2.40 | 2.68 |
| December | 180 | 70 | 115 | .353 | .41 |
| January | 120 | 55 | 90 | .276 | .32 |
| February | 120 | 70 | 95 | .291 | .31 |
| March | 4,820 | 55 | 803 | 2.46 | 2.84 |
| April | 1,290 | 264 | 526 | 1.61 | 1.80 |
| May | 499 | 182 | 266 | .816 | .94 |
| June | 1,740 | 145 | 484 | 1.48 | 1.65 |
| July | 471 | 94 | 165 | .506 | .58 |
| August | 116 | 78 | 91 | .282 | .32 |
| September | 300 | 85 | 133 | .408 | .46 |
| The year | 4,820 | 55 | 321 | .985 | 13.40 |

*Days of deficiency in discharge of Eau Claire River at Kelly, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 40 | ..... | 4 | ..... | 3 | ..... | ..... | 7 | 0.3 |
| 50 | 3 | 24 | 12 | 21 | ..... | ..... | 60 | 2.7 |
| 60 | 27 | 54 | 26 | 57 | ..... | 8 | 172 | 7.8 |
| 70 | 87 | 70 | 64 | 96 | 19 | 14 | 350 | 16.0 |
| 80 | 101 | 88 | 83 | 108 | 36 | 33 | 449 | 20.5 |
| 90 | 149 | 118 | 100 | 126 | 54 | 71 | 618 | 28.2 |
| 100 | 168 | 130 | 117 | 143 | 92 | 95 | 745 | 34.0 |
| 110 | 195 | 142 | 135 | 175 | 131 | 137 | 915 | 41.7 |
| 120 | 201 | 150 | 149 | 191 | 154 | 154 | 999 | 45.6 |
| 130 | 215 | 172 | 162 | 204 | 167 | 162 | 1,082 | 49.4 |
| 140 | 222 | 172 | 169 | 217 | 180 | 166 | 1,126 | 51.4 |
| 150 | 226 | 180 | 179 | 224 | 186 | 171 | 1,166 | 53.2 |
| 160 | 248 | 195 | 195 | 232 | 205 | 183 | 1,258 | 57.4 |
| 170 | 253 | 200 | 200 | 236 | 212 | 193 | 1,294 | 59.0 |
| 180 | 255 | 201 | 212 | 244 | 223 | 204 | 1,339 | 61.1 |
| 200 | 274 | 227 | 231 | 263 | 236 | 218 | 1,449 | 66.1 |
| 240 | 292 | 244 | 273 | 282 | 262 | 248 | 1,601 | 73.0 |
| 300 | 313 | 266 | 293 | 303 | 280 | 275 | 1,730 | 78.9 |
| 400 | 325 | 289 | 310 | 321 | 306 | 305 | 1,856 | 84.7 |
| 500 | 343 | 303 | 322 | 332 | 322 | 317 | 1,939 | 88.5 |
| 700 | 351 | 317 | 338 | 343 | 337 | 331 | 2,017 | 92.0 |
| 1,000 | 363 | 332 | 357 | 350 | 347 | 342 | 2,091 | 95.4 |
| 2,000 | 365 | 359 | 365 | 363 | 363 | 358 | 2,173 | 99.1 |
| 3,000 | ..... | 364 | ..... | 365 | 365 | 363 | 2,187 | 99.8 |
| 5,000 | ..... | 366 | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (second-feet) | 187 | 329 | 240 | 221 | 278 | 321 | ..... | ..... |
| Maximum (second-feet) | 1,120 | 3,150 | 1,290 | 2,450 | 2,450 | 4,820 | ..... | ..... |
| Minimum (second-feet) | 41 | 40 | 50 | 30 | 65 | 55 | ..... | ..... |

### BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E., at Weber Farm, 2 miles north of Stratford, Marathon County, and 1 mile above Chicago & Northwestern Railway bridge. Dill Creek enters from right 5 miles above station.

DRAINAGE AREA.—223 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1920.

GAGE.—Slope gage, reading from 1.0 to 15.6 feet, on right bank of river, and vertical staff gage, reading from 15 to 18 feet, at upper end of sloping gage; read by Christian Weber.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1 mile below gage or by wading about 1,000 feet below gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids 400 feet below gage. Both banks at gage are high and are overflowed only at stage of about 15 feet and above.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.7 feet at 6.30 a. m. August 7 (discharge, 5,330 second-feet); minimum stage, 1.34 feet October 3 (discharge, about 4 second-feet).

Maximum stage recorded during year ending September 30, 1920, 10.90 feet at 4.30 p. m. November 10 (discharge, 8,630 second-feet); minimum stage, 1.25 feet at 7 p. m. August 28 and 7 a. m. August 29 (discharge, about 2.5 second-feet).

1914–1920: Maximum stage recorded, 10.9 feet at 4.30 p. m. November 10, 1919 (discharge, 8,630 second-feet); minimum stage, 1.25 feet August 28 and 29, 1920 (discharge, about 2.5 second-feet).

The flood of June, 1914, reached a maximum height of 20.7 feet as determined by levels run to high-water marks.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 47 and 4,000 second-feet; poorly defined outside these limits. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods December 20, 1918, to March 31, 1919, and December 28, 1919, to March 27, 1920, during which stage-discharge relation was affected by ice, for which the discharge was not determined. Records good except for low stages for which they are fair.

*Discharge measurements of Big Eau Pleine River near Stratford, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| June 3 | W. G. Hoyt | 2.96 | 259 | June 9 | S. B. Soulé | 1.88 | 38 |
| Nov. 11 | S. B. Soulé | 6.86 | 2,940 | | | | |
| 11 | do | 6.58 | 2,680 | | | | |

*Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | |
| 1 | 5 | 47 | 17 | ..... | 310 | 98 | 43 | 50 | 720 | 18 |
| 2 | 5 | 39 | 17 | ..... | 238 | 208 | 208 | 36 | 310 | 15 |
| 3 | 4 | 39 | 19 | ..... | 266 | 120 | 272 | 27 | 182 | 13 |
| 4 | 5 | 83 | 20 | ..... | 280 | 103 | 175 | 33 | 200 | 12 |
| 5 | 7 | 92 | 19 | ..... | 447 | 141 | 114 | 44 | 269 | 18 |
| 6 | 7 | 83 | 20 | ..... | 403 | 175 | 85 | 31 | 998 | 25 |
| 7 | 8 | 71 | 20 | ..... | 1,890 | 295 | 77 | 25 | 3,770 | 22 |
| 8 | 10 | 98 | 22 | ..... | 3,770 | 230 | 103 | 29 | 1,330 | 17 |
| 9 | 13 | 114 | 24 | ..... | 1,570 | 158 | 71 | 31 | 470 | 15 |
| 10 | 22 | 92 | 25 | ..... | 2,790 | 125 | 77 | 27 | 260 | 15 |
| 11 | 20 | 71 | 27 | ..... | 2,300 | 90 | 344 | 22 | 158 | 12 |
| 12 | 17 | 53 | 28 | ..... | 1,110 | 65 | 310 | 18 | 101 | 12 |
| 13 | 15 | 50 | 31 | ..... | 694 | 58 | 208 | 17 | 75 | 11 |
| 14 | 14 | 43 | 36 | ..... | 424 | 46 | 114 | 25 | 60 | 9.5 |
| 15 | 14 | 36 | 36 | ..... | 310 | 49 | 71 | 24 | 50 | 9.5 |
| 16 | 11 | 36 | 36 | ..... | 244 | 382 | 53 | 18 | 40 | 9.5 |
| 17 | 11 | 53 | 43 | ..... | 280 | 363 | 46 | 15 | 33 | 9.5 |
| 18 | 11 | 77 | 47 | ..... | 363 | 244 | 46 | 13 | 33 | 9.5 |
| 19 | 10 | 87 | 50 | ..... | 258 | 175 | 125 | 12 | 33 | 9.5 |
| 20 | 11 | 83 | ..... | ..... | 295 | 185 | 225 | 12 | 33 | 9.5 |
| 21 | 10 | 67 | ..... | ..... | 249 | 85 | 81 | 11 | 220 | 19 |
| 22 | 8 | 53 | ..... | ..... | 195 | 71 | 39 | 9.5 | 112 | 27 |
| 23 | 10 | 39 | ..... | ..... | 165 | 125 | 31 | 9.5 | 60 | 27 |
| 24 | 11 | 31 | ..... | ..... | 129 | 150 | 1,970 | 8.0 | 44 | 22 |
| 25 | 11 | 27 | ..... | ..... | 107 | 120 | 2,050 | 12 | 31 | 22 |
| 26 | 11 | 24 | ..... | ..... | 85 | 81 | 840 | 55 | 25 | 15 |
| 27 | 19 | 20 | ..... | ..... | 71 | 58 | 905 | 44 | 22 | 15 |
| 28 | 92 | 22 | ..... | ..... | 71 | 43 | 205 | 33 | 18 | 13 |
| 29 | 114 | 20 | ..... | ..... | 61 | 34 | 120 | 40 | 18 | 27 |
| 30 | 83 | 19 | ..... | ..... | 58 | 28 | 71 | 260 | 18 | 233 |
| 31 | 63 | ..... | ..... | ..... | ..... | 31 | ..... | 1,410 | 22 | ..... |
| 1919–20. | | | | | | | | | | |
| 1 | 108 | 1,250 | 36 | ..... | 580 | 94 | 33 | 244 | 5 | 5 |
| 2 | 145 | 630 | 36 | ..... | 760 | 77 | 30 | 137 | 4 | 5 |
| 3 | 194 | 416 | 36 | ..... | 483 | 61 | 25 | 98 | 4 | 5 |
| 4 | 115 | 395 | 36 | ..... | 460 | 50 | 24 | 77 | 4 | 5 |
| 5 | 94 | 302 | 36 | ..... | 319 | 43 | 22 | 43 | 4 | 5 |
| 6 | 74 | 231 | 36 | ..... | 244 | 40 | 22 | 37 | 5 | 5 |
| 7 | 55 | 218 | 31 | ..... | 194 | 33 | 27 | 50 | 17 | 5 |
| 8 | 43 | 206 | 36 | ..... | 119 | 31 | 33 | 55 | 14 | 5 |
| 9 | 43 | 182 | 43 | ..... | 119 | 30 | 30 | 46 | 13 | 5 |
| 10 | 36 | 7,200 | 31 | ..... | 119 | 31 | 27 | 33 | 9 | 5 |
| 11 | 36 | 2,810 | 31 | ..... | 119 | 530 | 102 | 30 | 7 | 7 |
| 12 | 36 | 990 | 31 | ..... | 130 | 483 | 272 | 25 | 6 | 7 |
| 13 | 36 | 460 | 31 | ..... | 119 | 244 | 218 | 33 | 6 | 7 |
| 14 | 31 | 336 | 31 | ..... | 102 | 159 | 206 | 102 | 6 | 6 |
| 15 | 31 | 231 | 31 | ..... | 94 | 108 | 148 | 50 | 6 | 6 |
| 16 | 30 | 194 | 27 | ..... | 87 | 81 | 3,140 | 30 | 6 | 5 |
| 17 | 27 | 170 | 25 | ..... | 77 | 61 | 1,390 | 22 | 5 | 4 |
| 18 | 27 | 355 | 24 | ..... | 67 | 58 | 555 | 17 | 5 | 3 |
| 19 | 27 | 148 | 24 | ..... | 58 | 108 | 258 | 17 | 5 | 4 |
| 20 | 36 | 104 | 24 | ..... | 58 | 272 | 148 | 16 | 4 | 5 |
| 21 | 43 | 81 | 24 | ..... | 58 | 302 | 115 | 14 | 4 | 5 |
| 22 | 43 | 94 | 24 | ..... | 81 | 194 | 108 | 14 | 4 | 5 |
| 23 | 40 | 102 | 24 | ..... | 2,310 | 1,630 | 81 | 12 | 3 | 5 |
| 24 | 36 | 218 | 24 | ..... | 930 | 760 | 55 | 10 | 3 | 5 |
| 25 | 680 | 81 | 24 | ..... | 530 | 374 | 40 | 9 | 3 | 5 |
| 26 | 555 | 58 | 24 | ..... | 319 | 231 | 33 | 9 | 3 | 5 |
| 27 | 258 | 43 | 24 | ..... | 218 | 159 | 31 | 8 | 3 | 5 |
| 28 | 194 | 36 | ..... | 3,140 | 194 | 98 | 31 | 6 | 3 | 4 |
| 29 | 159 | 36 | ..... | 2,410 | 159 | 67 | 374 | 6 | 3 | 4 |
| 30 | 580 | 36 | ..... | 1,110 | 126 | 67 | 580 | 6 | 5 | 4 |
| 31 | 3,990 | ..... | ..... | 705 | ..... | 40 | ..... | 5 | 5 | ..... |

*Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 223 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 114 | 4 | 21.0 | 0.094 | 0.11 |
| November | 114 | 19 | 55.6 | .249 | .28 |
| December 1–19 | 50 | 17 | 28.4 | .127 | .09 |
| April | 3,770 | 58 | 648 | 2.91 | 3.25 |
| May | 382 | 28 | 134 | .601 | .69 |
| June | 2,050 | 31 | 303 | 1.36 | 1.52 |
| July | 1,410 | 8.0 | 77.5 | .348 | .40 |
| August | 3,770 | 18 | 313 | 1.40 | 1.61 |
| September | 233 | 9.5 | 23.0 | .103 | .11 |
| 1919–20. | | | | | |
| October | 3,990 | 27 | 252 | 1.13 | 1.30 |
| November | 7,200 | 36 | 587 | 2.63 | 2.93 |
| December 1–27 | 43 | 24 | 29.8 | .134 | .13 |
| March 28–31 | 3,140 | 705 | 1,840 | 8.25 | 1.23 |
| April | 2,310 | 58 | 308 | 1.38 | 1.54 |
| May | 1,630 | 30 | 210 | .942 | 1.09 |
| June | 3,140 | 22 | 272 | 1.22 | 1.36 |
| July | 244 | 5 | 40.7 | .182 | .21 |
| August | 17 | 3 | 5.61 | .0252 | .03 |
| September | 7 | 3 | 5.03 | .0226 | .03 |

### PLOVER RIVER NEAR STEVENS POINT, WIS.

LOCATION.—In sec. 1, T. 24 N., R. 8 E., at Fast Waters highway bridge, 7 miles above mouth of river and 5 miles northeast of Stevens Point, Portage County.

DRAINAGE AREA.—136 square miles.

RECORDS AVAILABLE.—January 5, 1914, to December 31, 1919, when station was discontinued.

GAGE.—Vertical staff gage bolted to left abutment, downstream side of bridge; read by M. E. Van Order.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and small rock; free from vegetation; permanent. At high stages both banks are overflowed around the bridge. Control not well defined but is probably small rapids below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 1, 1918, to December 31, 1919, 4.3 feet at 5 p. m. June 27, 1919 (discharge, 1,230 second-feet); minimum discharge probably somewhat less than 80 second-feet during parts of December, January, and March (stage-discharge relation affected by ice).

1914–1919: Maximum stage recorded, 4.75 feet June 5, 1914 (discharge, about 1,570 second-feet); minimum discharge, estimated 45 second-feet, February 5–7, 1917 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Two dams above station are used in connection with grist mills, but as they have little pondage the flow at gage, except for brief periods, is nearly natural.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 82 and 410 second-feet; poorly defined outside these limits. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records fair except for extreme low stages, for which they are subject to error on account of diurnal fluctuation at gage; winter records poor.

*Discharge measurements of Plover River near Stevens Point, Wis., during the period Oct. 1, 1918, to Dec. 31, 1919.*

[Made by S. B. Soulé.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| 1919. | *Feet.* | *Sec.-ft.* | 1919. | *Feet.* | *Sec.-ft.* | 1919. | *Feet.* | *Sec.-ft.* |
| Jan. 8[a] | 1.80 | 95 | June 4 | 1.68 | 214 | Sept. 25 | 1.57 | 190 |
| Feb. 18[b] | 1.09 | 91 | Sept. 25 | 1.56 | 191 | Dec. 19[a] | 1.95 | 107 |
| Mar. 13[a] | 1.56 | 104 | | | | | | |

[a] Complete ice cover at measuring section; incomplete cover at gage.
[b] Incomplete ice cover at gage.

*Daily discharge, in second-feet, of Plover River near Stevens Point, Wis., for the period Oct. 1, 1918, to Dec. 31, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 132 | 132 | 115 | | | | 234 | 256 | 150 | 245 | 317 | 141 |
| 2 | 106 | 132 | 115 | | | | 212 | 245 | 170 | 223 | 330 | 132 |
| 3 | 106 | 150 | 111 | | | | 190 | 234 | 186 | 223 | 382 | 132 |
| 4 | 85 | 150 | 106 | | | | 170 | 256 | 201 | 180 | 410 | 132 |
| 5 | 101 | 150 | 111 | | 85 | 80 | 190 | 292 | 180 | 160 | 382 | 132 |
| 6 | 101 | 170 | 106 | | | | 190 | 268 | 180 | 180 | 382 | 132 |
| 7 | 111 | 150 | 101 | | | | 212 | 280 | 180 | 180 | 438 | 141 |
| 8 | 101 | 141 | 114 | | | | 245 | 256 | 190 | 170 | 468 | 141 |
| 9 | 90 | 150 | 123 | | | | 330 | 234 | 268 | 180 | 438 | 150 |
| 10 | 98 | 180 | 111 | | | | 468 | 223 | 268 | 180 | 438 | 150 |
| 11 | 98 | 170 | 132 | 80 | | | 532 | 234 | 268 | 180 | 410 | 150 |
| 12 | 95 | 141 | 123 | | | | 468 | 223 | 317 | 160 | 330 | 141 |
| 13 | 111 | 150 | 132 | | | | 500 | 212 | 268 | 190 | 292 | 141 |
| 14 | 106 | 150 | 123 | | | | 500 | 212 | 245 | 201 | 245 | 141 |
| 15 | 101 | 160 | 111 | | | 170 | 438 | 212 | 212 | 180 | 223 | 141 |
| 16 | 98 | 150 | 106 | | 120 | | 382 | 190 | 180 | 160 | 201 | 141 |
| 17 | 90 | 190 | 111 | | | | 268 | 170 | 190 | 160 | 201 | 150 |
| 18 | 95 | 190 | 101 | | | | 256 | 170 | 170 | 150 | 201 | 160 |
| 19 | 98 | 190 | 95 | | | 396 | 268 | 170 | 180 | 150 | 180 | 180 |
| 20 | 114 | 170 | 95 | | | 382 | 292 | 160 | 180 | 160 | 180 | 160 |
| 21 | 150 | 170 | 98 | | | 382 | 256 | 170 | 180 | 160 | 180 | 160 |
| 22 | 150 | 160 | 132 | | | 382 | 245 | 170 | 201 | 150 | 160 | 160 |
| 23 | 150 | 150 | 114 | | | 438 | 234 | 170 | 201 | 141 | 160 | 150 |
| 24 | 132 | 150 | 106 | | | 371 | 212 | 180 | 438 | 141 | 180 | 150 |
| 25 | 132 | 132 | 95 | | 130 | 304 | 201 | 212 | 565 | 141 | 180 | 141 |
| 26 | 132 | 132 | 90 | 115 | | 286 | 201 | 190 | 950 | 160 | 150 | 141 |
| 27 | 132 | 114 | | | | 268 | 212 | 160 | 1,160 | 180 | 141 | 141 |
| 28 | 141 | 115 | | | | 274 | 212 | 150 | 950 | 190 | 141 | 160 |
| 29 | 150 | 115 | 80 | | ..... | 280 | 190 | 150 | 670 | 190 | 141 | 180 |
| 30 | 132 | 115 | | | ..... | 280 | 190 | 150 | 438 | 201 | 141 | 150 |
| 31 | 132 | ..... | | | ..... | 245 | ..... | 132 | ..... | 245 | 141 | ..... |

| Day. | Oct. | Nov. | Dec. | Day. | Oct. | Nov. | Dec. | Day. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | 1919. | | | | 1919. | | | |
| 1 | 160 | 410 | 150 | 11 | 170 | 330 | 115 | 21 | 150 | 201 | 110 |
| 2 | 150 | 438 | 140 | 12 | 190 | 382 | 115 | 22 | 150 | 201 | 115 |
| 3 | 150 | 382 | 140 | 13 | 170 | 356 | 115 | 23 | 132 | 212 | 125 |
| 4 | 150 | 317 | 130 | 14 | 150 | 292 | 115 | 24 | 141 | 201 | 125 |
| 5 | 190 | 304 | 130 | 15 | 160 | 268 | 115 | 25 | 132 | 180 | 125 |
| 6 | 170 | 256 | 125 | 16 | 160 | 292 | 110 | 26 | 132 | 160 | 125 |
| 7 | 160 | 268 | 125 | 17 | 150 | 280 | 110 | 27 | 141 | 160 | 130 |
| 8 | 160 | 245 | 125 | 18 | 150 | 268 | 110 | 28 | 132 | 160 | 130 |
| 9 | 180 | 234 | 115 | 19 | 170 | 245 | 105 | 29 | 132 | 160 | 130 |
| 10 | 170 | 292 | 115 | 20 | 150 | 212 | 105 | 30 | 160 | 150 | 130 |
| | | | | | | | | 31 | 330 | ..... | 130 |

NOTE.—Stage-discharge relation affected by ice, Nov. 28 to Dec. 2, 1918, Dec. 27, 1918, to Mar. 18, 1919, and Dec. 1–31, 1919. Discharge interpolated June 3 on account of lack of gage readings. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Plover River near Stevens Point, Wis., for the period Oct. 1, 1918, to Dec. 31, 1919.*

[Drainage area, 136 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 150 | 85 | 115 | 0.846 | 0.98 |
| November | 190 | 115 | 151 | 1.11 | 1.24 |
| December | 132 | ..... | 106 | .779 | .90 |
| January | ..... | ..... | 92.4 | .679 | .78 |
| February | ..... | ..... | 110 | .809 | .84 |
| March | 438 | ..... | 208 | 1.53 | 1.76 |
| April | 532 | 170 | 283 | 2.08 | 2.32 |
| May | 292 | 132 | 204 | 1.50 | 1.73 |
| June | 1,160 | 150 | 331 | 2.43 | 2.71 |
| July | 245 | 141 | 178 | 1.31 | 1.51 |
| August | 468 | 141 | 263 | 1.93 | 2.22 |
| September | 180 | 132 | 147 | 1.08 | 1.20 |
| The year | 1,160 | ..... | 183 | 1.35 | 18.19 |
| 1919. | | | | | |
| October | 330 | 132 | 161 | 1.18 | 1.36 |
| November | 438 | 150 | 262 | 1.93 | 2.15 |
| December | 150 | 105 | 122 | .897 | 1.03 |

*Days of deficiency in discharge of Plover River near Steven's Point, Wis., for the years ending Sept. 30, 1915–1919.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | Oct. 1, 1914, to Sept. 30, 1919. | |
|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | Total days. | Per cent of time. |
| 40 | ..... | ..... | 0 | ..... | ..... | 0 | 0.0 |
| 50 | 0 | 0 | 7 | 0 | ..... | 7 | .4 |
| 60 | 11 | 4 | 22 | 45 | ..... | 82 | 4.5 |
| 70 | 21 | 7 | 39 | 77 | 0 | 144 | 7.9 |
| 80 | 41 | 14 | 61 | 78 | 35 | 229 | 12.5 |
| 90 | 47 | 47 | 82 | 83 | 49 | 308 | 16.9 |
| 100 | 101 | 88 | 95 | 115 | 59 | 458 | 25.1 |
| 110 | 111 | 111 | 109 | 138 | 72 | 541 | 29.6 |
| 120 | 149 | 146 | 120 | 186 | 109 | 710 | 38.9 |
| 130 | 171 | 162 | 156 | 199 | 120 | 808 | 44.2 |
| 140 | 209 | 201 | 183 | 231 | 140 | 964 | 52.8 |
| 150 | 242 | 211 | 219 | 256 | 191 | 1,119 | 61.3 |
| 160 | 272 | 231 | 231 | 262 | 209 | 1,205 | 66.0 |
| 170 | 287 | 236 | 255 | 272 | 231 | 1,281 | 70.2 |
| 180 | 308 | 254 | 273 | 273 | 255 | 1,363 | 74.6 |
| 200 | 327 | 262 | 303 | 285 | 271 | 1,448 | 79.3 |
| 250 | 347 | 303 | 325 | 324 | 309 | 1,608 | 88.1 |
| 350 | 358 | 344 | 349 | 340 | 336 | 1,727 | 94.6 |
| 500 | 365 | 358 | 365 | 360 | 359 | 1,807 | 99.0 |
| 750 | ..... | 366 | ..... | 365 | 362 | 1,823 | 99.8 |
| 1,000 | ..... | ..... | ..... | ..... | 364 | 1,825 | 99.9 |
| 1,500 | ..... | ..... | ..... | ..... | 365 | 1,826 | 100.0 |
| Mean discharge (sec.-ft.) | 143 | 173 | 153 | 151 | 183 | ..... | ..... |
| Maximum (sec.-ft.) | 466 | 711 | 438 | 670 | 1,160 | ..... | ..... |
| Minimum (sec.-ft.) | 60 | 56 | 45 | 55 | 80 | ..... | ..... |

### BARABOO RIVER NEAR BARABOO, WIS.

LOCATION.—In sec. 33, T. 12 N., R. 7 E., at highway bridge 4 miles downstream from Baraboo, Sauk County, 3 miles below creek that rises near Devils Lake and comes in from right, and 15 miles above mouth of river.

DRAINAGE AREA.—572 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 18, 1913, to September 30, 1920.

GAGE.—Chain gage, attached to upstream side of bridge; read by Theodore Schneider.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Control not well defined. Water is confined to one channel except at flood stages when right bank is overflowed for a distance of 1,000 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.02 feet at 4 p. m. March 19 (discharge, about 4,070 second-feet); minimum stage, 1.00 foot at 8 a. m. September 8 (discharge, about 86 second-feet).

Maximum stage recorded during year ending September 30, 1920, 17.08 feet at 8 a. m. June 22 (discharge, 7,180 second-feet); minimum stage, 1.34 feet at 8 a. m. July 25 (discharge, 97 second-feet).

1914–1920: Maximum stage recorded, about 17.5 feet March 26, 1917 (discharge, about 7,900 second-feet)[9]; minimum stage, 0.71 foot July 26, 1916 (discharge, 76 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—In the vicinity of Baraboo, 4 miles above station, there are four dams, and one at Reedsburg, 18 miles above station. Smaller plants are also operated on tributaries. The operation of these various plants causes diurnal fluctuation at gage of about 0.3 foot at low stages. Mean monthly discharge probably represents nearly the natural flow.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice. Two rating curves used; one, applicable October 1, 1918, to March 7, 1919, fairly well defined between 170 and 2,600 second-feet, the other, applicable March 8, 1919, to September 30, 1920, fairly well defined between 150 and 6,000 second-feet and was used as basic curve for the indirect method for shifting control during periods March 24 to November 27, 1919, and March 16 to September 30, 1920. Gage read to hundredths twice daily. During periods when shifting-control method was not used daily discharge was ascertained by applying mean daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records fair.

*Discharge measurements of Baraboo River near Baraboo, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Dec. 31[a] | R. S. Huffman | 2.63 | 242 | Jan. 5[c] | Harris and Soulé | 2.93 | 230 |
| | | | | Feb. 24[c] | W. G. Hoyt | 2.73 | 158 |
| 1919. | | | | Mar. 15 | S. B. Soulé | 10.99 | 1,550 |
| Feb. 11[a] | W. G. Hoyt | 1.39 | 108 | 16 | do | 11.70 | 2,070 |
| Mar. 19[b] | S. B. Soulé | 14.98 | 4,490 | May 7 | W. G. Hoyt | 2.51 | 224 |
| 24 | do | 4.18 | 443 | 28 | do | 4.26 | 445 |
| Apr. 4 | do | 2.41 | 224 | June 18 | do | 16.23 | 5,960 |
| July 8 | do | 2.32 | 238 | 20 | do | 15.49 | 5,000 |
| Sept. 26 | do | 2.44 | 239 | 27 | do | 3.36 | 306 |
| Dec. 3[c] | Harris and Soulé | 3.37 | 320 | Aug. 26 | S. B. Soulé | 2.00 | 206 |
| | | | | Sept. 23 | do | 1.91 | 166 |

[a] Incomplete ice cover at control.
[b] River out of banks at regular measuring section; measurement made from bridge about 3 miles upstream.
[c] Complete ice cover.

[9] Formerly published as 4,200 second-feet; changed on account of revision of rating curve.

*Daily discharge, in second-feet, of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 188 | 294 | 213 | 240 | 246 | 175 | 285 | 411 | 224 | 257 | 411 | 140 |
| 2 | 142 | 232 | 193 | 230 | 220 | 175 | 180 | 575 | 313 | 285 | 369 | 129 |
| 3 | 162 | 196 | 172 | 225 | 200 | 175 | 231 | 515 | 455 | 244 | 369 | 137 |
| 4 | 162 | 182 | 182 | 225 | 175 | 180 | 244 | 575 | 500 | 228 | 355 | 129 |
| 5 | 130 | 280 | 157 | 220 | 150 | 180 | 250 | 485 | 411 | 244 | 313 | 140 |
| 6 | 150 | 252 | 176 | 215 | 135 | 190 | 231 | 500 | 455 | 134 | 271 | 103 |
| 7 | 172 | 232 | 194 | 215 | 125 | 200 | 299 | 655 | 355 | 174 | 271 | 121 |
| 8 | 188 | 220 | 194 | 215 | 120 | 168 | 591 | 890 | 440 | 212 | 250 | 123 |
| 9 | 193 | 252 | 220 | 215 | 115 | 212 | 639 | 1,150 | 470 | 192 | 218 | 120 |
| 10 | 188 | 220 | 266 | 213 | 110 | 313 | 799 | 1,260 | 455 | 174 | 250 | 154 |
| 11 | 195 | 193 | 315 | 206 | 110 | 440 | 870 | 1,210 | 687 | 128 | 244 | 120 |
| 12 | 157 | 232 | 378 | 252 | 110 | 815 | 850 | 751 | 1,070 | 168 | 156 | 148 |
| 13 | 124 | 188 | 422 | 280 | 130 | 1,210 | 799 | 440 | 1,210 | 168 | 162 | 168 |
| 14 | 213 | 195 | 407 | 287 | 265 | 1,540 | 687 | 383 | 1,190 | 174 | 110 | 174 |
| 15 | 159 | 200 | 350 | 280 | 335 | 1,540 | 591 | 397 | 870 | 168 | 156 | 168 |
| 16 | 166 | 198 | 364 | 308 | 335 | 2,630 | 719 | 327 | 655 | 162 | 112 | 143 |
| 17 | 154 | 192 | 350 | 301 | 320 | 3,520 | 1,050 | 313 | 560 | 192 | 109 | 127 |
| 18 | 135 | 175 | 294 | 252 | 300 | 3,930 | 1,150 | 285 | 930 | 192 | 205 | 143 |
| 19 | 166 | 226 | 322 | 199 | 280 | 4,050 | 1,070 | 313 | 1,130 | 180 | 168 | 218 |
| 20 | 198 | 239 | 308 | 239 | 239 | 3,220 | 1,070 | 278 | 1,030 | 186 | 152 | 142 |
| 21 | 190 | 225 | 273 | 206 | 213 | 2,240 | 1,070 | 250 | 639 | 180 | 205 | 313 |
| 22 | 147 | 220 | 273 | 246 | 199 | 1,110 | 832 | 271 | 397 | 162 | 278 | 369 |
| 23 | 183 | 215 | 322 | 273 | 220 | 591 | 703 | 313 | 341 | 156 | 218 | 205 |
| 24 | 190 | 205 | 310 | 273 | 213 | 425 | 591 | 313 | 355 | 146 | 257 | 231 |
| 25 | 178 | 193 | 285 | 259 | 215 | 383 | 485 | 327 | 313 | 155 | 231 | 192 |
| 26 | 183 | 232 | 275 | 266 | 200 | 369 | 455 | 257 | 271 | 151 | 156 | 186 |
| 27 | 206 | 216 | 260 | 308 | 190 | 369 | 397 | 313 | 271 | 168 | 152 | 150 |
| 28 | 252 | 226 | 250 | 322 | 175 | 327 | 355 | 285 | 341 | 154 | 136 | 156 |
| 29 | 213 | 246 | 215 | 315 | ..... | 299 | 313 | 250 | 299 | 198 | 144 | 500 |
| 30 | 336 | 213 | 215 | 280 | ..... | 278 | 285 | 285 | 257 | 145 | 118 | 767 |
| 31 | 350 | ..... | 240 | 273 | ..... | 285 | ..... | 205 | ..... | 192 | 128 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 799 | 930 | 325 | 220 | 200 | 160 | 1,050 | 369 | 212 | 623 | 162 | 751 |
| 2 | 815 | 815 | 300 | 245 | 230 | 190 | 1,190 | 341 | 212 | 703 | 156 | 470 |
| 3 | 560 | 767 | 285 | 240 | 205 | 190 | 1,600 | 327 | 218 | 799 | 156 | 369 |
| 4 | 560 | 607 | 280 | 200 | 250 | 205 | 1,460 | 285 | 212 | 440 | 168 | 327 |
| 5 | 1,600 | 383 | 270 | 200 | 230 | 155 | 1,340 | 271 | 174 | 285 | 168 | 299 |
| 6 | 1,010 | 299 | 245 | 220 | 240 | 155 | 1,240 | 257 | 186 | 313 | 151 | 244 |
| 7 | 591 | 313 | 225 | 190 | 230 | 130 | 751 | 257 | 198 | 327 | 162 | 244 |
| 8 | 369 | 250 | 220 | 210 | 185 | 225 | 545 | 264 | 355 | 455 | 127 | 231 |
| 9 | 285 | 264 | 170 | 205 | 255 | 230 | 440 | 205 | 285 | 560 | 122 | 250 |
| 10 | 271 | 703 | 240 | 145 | 265 | 220 | 383 | 205 | 264 | 545 | 186 | 231 |
| 11 | 257 | 1,460 | 180 | 180 | 245 | 370 | 369 | 205 | 231 | 369 | 192 | 238 |
| 12 | 257 | 1,390 | 205 | 265 | 250 | 1,290 | 383 | 271 | 224 | 278 | 186 | 212 |
| 13 | 224 | 1,310 | 200 | 215 | 240 | 1,210 | 383 | 238 | 205 | 257 | 192 | 244 |
| 14 | 257 | 1,240 | 180 | 225 | 215 | 1,310 | 369 | 224 | 264 | 238 | 591 | 271 |
| 15 | 264 | 970 | 205 | 270 | 205 | 1,460 | 327 | 271 | 485 | 205 | 639 | 231 |
| 16 | 257 | 455 | 155 | 240 | 245 | 2,140 | 299 | 218 | 1,900 | 218 | 440 | 218 |
| 17 | 212 | 205 | 205 | 200 | 205 | 2,270 | 278 | 186 | 3,880 | 218 | 257 | 238 |
| 18 | 212 | 257 | 220 | 175 | 210 | 2,140 | 244 | 224 | 5,850 | 224 | 224 | 355 |
| 19 | 192 | 224 | 220 | 265 | 185 | 2,170 | 264 | 257 | 5,200 | 174 | 212 | 327 |
| 20 | 198 | 224 | 160 | 250 | 240 | 2,080 | 530 | 271 | 4,550 | 156 | 455 | 271 |
| 21 | 168 | 218 | 170 | 280 | 150 | 2,020 | 799 | 238 | 3,610 | 155 | 560 | 231 |
| 22 | 218 | 205 | 255 | 240 | 180 | 1,960 | 735 | 231 | 6,330 | 150 | 515 | 244 |
| 23 | 205 | 186 | 250 | 245 | 190 | 1,570 | 970 | 799 | 2,020 | 155 | 250 | 186 |
| 24 | 162 | 212 | 250 | 230 | 180 | 1,320 | 850 | 1,320 | 735 | 119 | 218 | 192 |
| 25 | 257 | 285 | 225 | 170 | 190 | 1,440 | 687 | 1,110 | 500 | 105 | 212 | 192 |
| 26 | 341 | 250 | 205 | 270 | 180 | 2,140 | 500 | 990 | 383 | 142 | 205 | 168 |
| 27 | 341 | 198 | 175 | 250 | 180 | 2,080 | 470 | 815 | 299 | 142 | 218 | 156 |
| 28 | 238 | 200 | 225 | 250 | 175 | 2,020 | 383 | 425 | 285 | 113 | 186 | 192 |
| 29 | 278 | 190 | 250 | 265 | 140 | 2,080 | 470 | 278 | 285 | 130 | 470 | 186 |
| 30 | 250 | 200 | 255 | 255 | ..... | 1,660 | 411 | 238 | 397 | 156 | 1,390 | 192 |
| 31 | 687 | ..... | 300 | 250 | ..... | 1,630 | ..... | 192 | ..... | 168 | 1,150 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 21–24, 1918, Dec. 21, 1918, to Jan. 9, 1919, Feb. 3–18, Feb. 25 to Mar. 7, 1919, and Nov. 28, 1919, to Mar. 15, 1920; discharge ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Discharge interpolated June 17 and 19, 1920, on account of lack of gage readings.

*Monthly discharge of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 572 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 350 | 124 | 186 | 0.325 | 0.37 |
| November | 294 | 175 | 221 | .386 | .43 |
| December | 422 | 157 | 273 | .477 | .55 |
| January | 322 | 199 | 253 | .442 | .51 |
| February | 335 | 110 | 195 | .341 | .37 |
| March | 4,050 | 168 | 1,020 | 1.78 | 2.05 |
| April | 1,150 | 180 | 603 | 1.05 | 1.17 |
| May | 1,260 | 205 | 478 | .836 | .96 |
| June | 1,240 | 224 | 564 | .986 | 1.10 |
| July | 285 | 128 | 183 | .320 | .37 |
| August | 411 | 109 | 215 | .376 | .43 |
| September | 767 | 103 | 197 | .344 | .38 |
| The year | 4,050 | 103 | 366 | .640 | 8.69 |
| 1919–20. | | | | | |
| October | 1,600 | 162 | 398 | .696 | .80 |
| November | 1,460 | 186 | 508 | .888 | .99 |
| December | 325 | 155 | 227 | .397 | .46 |
| January | 280 | 145 | 229 | .400 | .46 |
| February | 265 | 140 | 211 | .369 | .40 |
| March | 2,270 | 130 | 1,230 | 2.15 | 2.48 |
| April | 1,600 | 244 | 657 | 1.15 | 1.28 |
| May | 1,320 | 186 | 380 | .664 | .77 |
| June | 6,330 | 174 | 1,330 | 2.33 | 2.60 |
| July | 799 | 105 | 288 | .503 | .58 |
| August | 1,390 | 122 | 333 | .582 | .67 |
| September | 751 | 156 | 265 | .463 | .52 |
| The year | 6,330 | 105 | 504 | .881 | 12.01 |

*Days of deficiency in discharge of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 70 | ..... | ..... | ..... | 0 | ..... | ..... | 0 | 0.0 |
| 80 | ..... | ..... | ..... | 1 | ..... | ..... | 1 | .0 |
| 90 | ..... | 0 | 0 | 3 | ..... | ..... | 3 | .1 |
| 100 | 0 | 1 | 2 | 5 | 0 | 0 | 8 | .4 |
| 120 | 21 | 7 | 6 | 12 | 12 | 3 | 61 | 2.8 |
| 140 | 38 | 14 | 13 | 25 | 30 | 7 | 127 | 5.8 |
| 160 | 54 | 25 | 30 | 66 | 56 | 24 | 255 | 11.6 |
| 180 | 94 | 47 | 60 | 106 | 92 | 42 | 441 | 20.1 |
| 200 | 154 | 69 | 104 | 145 | 132 | 76 | 680 | 31.0 |
| 230 | 198 | 89 | 150 | 187 | 172 | 140 | 936 | 42.7 |
| 260 | 224 | 137 | 183 | 217 | 211 | 206 | 1,178 | 53.7 |
| 290 | 234 | 168 | 200 | 226 | 242 | 240 | 1,310 | 59.8 |
| 340 | 243 | 209 | 228 | 262 | 275 | 254 | 1,471 | 67.1 |
| 400 | 262 | 247 | 254 | 282 | 296 | 273 | 1,614 | 73.6 |
| 500 | 277 | 276 | 277 | 300 | 315 | 286 | 1,731 | 79.0 |
| 700 | 305 | 305 | 304 | 314 | 329 | 303 | 1,860 | 84.8 |
| 1,000 | 322 | 328 | 327 | 321 | 342 | 322 | 1,962 | 89.5 |
| 1,500 | 354 | 354 | 348 | 339 | 357 | 342 | 2,094 | 95.5 |
| 2,000 | 363 | 359 | 355 | 346 | 359 | 349 | 2,131 | 97.2 |
| 2,500 | 365 | 366 | 358 | 356 | 360 | 360 | 2,165 | 98.8 |
| 3,000 | ..... | ..... | 361 | 361 | 361 | 360 | 2,174 | 99.2 |
| 4,000 | ..... | ..... | 364 | 365 | 364 | 362 | 2,186 | 99.7 |
| 5,000 | ..... | ..... | 365 | ..... | 365 | 363 | 2,189 | 99.9 |
| 10,000 | ..... | ..... | ..... | ..... | ..... | 366 | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 380 | 458 | 465 | 457 | 366 | 504 | ..... | ..... |
| Maximum (sec.-ft.) | 1,660 | 2,460 | 4,200 | 3,240 | 4,050 | 6,330 | ..... | ..... |
| Minimum (sec.-ft.) | a 110 | 100 | 95 | 80 | 103 | 105 | ..... | ..... |

a Approximate.

### KICKAPOO RIVER AT GAYS MILLS, WIS.

LOCATION.—In sec. 28, T. 10 N., R. 4 W., at highway bridge immediately below Norwood Mill, in Gays Mills, Crawford County, 25 miles above mouth of river, and 2 miles below mouth of Tainter Creek, which enters from right.

DRAINAGE AREA.—629 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 25, 1913, to September 30, 1920.

GAGE.—Chain gage fastened to downstream side of bridge; read by N. T. Norwood and Robert Atwood.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rock covered by a deposit of sand. Banks at gage section fairly high and not subject to overflow at ordinary high-water stages. Control is at head of small rapids about 300 feet below gage; not permanent; the plotting of discharge measurements indicates that at a stage of about 2 feet on the gage, the control is changed to some point below, causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 11.9 feet at 5 p. m. March 17 (discharge, about 3,950 second-feet); minimum stage, 1.10 feet at 5.45 p. m. September 16 and 9 a. m. September 28 (discharge, about 172 second-feet).

Maximum stage recorded during year ending September 30, 1920, 10.5 feet at 5.45 a. m. June 18 (discharge, 3,200 second-feet); minimum discharge, estimated 140 second-feet January 5 (stage-discharge relation affected by ice).

1914–1920: Maximum stage recorded, 15.05 feet March 24, 1917 (discharge, about 6,300 second-feet); minimum discharge, about 100 second-feet during latter part of January, 1915 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Mills at Gays Mills immediately above the station, at Soldiers Grove, about 7 miles upstream, and at several points above Soldiers Grove, use comparatively little storage, so that the recorded flow past the station represents nearly the natural flow. During low stages a small diurnal fluctuation is observed at the gage.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice. One poorly defined rating curve used during 1919 and 1920; curve was used by direct method October 1, 1918, to March 18, 1919, and as basic curve for the indirect method for shifting control, March 19 to November 30, 1919, and March 21 to September 30, 1920. Gage read to quarter-tenths twice daily. During periods when shifting-control method was not used, daily discharge was ascertained by applying mean daily gage height to rating table except for periods, November 27 to December 8, 1918, December 26, 1918, to January 21, 1919, February 2–10, February 27 to March 7, 1919, and December 1, 1919, to March 20, 1920, during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records poor.

*Discharge measurements of Kickapoo River at Gays Mills, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Apr. 3 | W. G. Hoyt | 1.65 | 355 | Jan. 26[b] | J. W. Harris | 2.50 | 264 |
| June 18 | S. B. Soulé | 2.67 | 562 | Feb. 26[b] | do | 2.00 | 251 |
| Oct. 11 | do | 1.87 | 368 | May 26 | W. G. Hoyt | 3.01 | 616 |
| Dec. 22[a] | J. W. Harris | 2.55 | 297 | Sept. 22 | S. B. Soulé | 1.55 | 308 |

[a] Nearly complete ice cover.
[b] Complete ice cover.

*Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 272 | 315 | 225 | 210 | 235 | 210 | 375 | 405 | 315 | 285 | 580 | 210 |
| 2 | 272 | 300 | 225 | 210 | 235 | 210 | 375 | 390 | 435 | 258 | 272 | 210 |
| 3 | 272 | 330 | 230 | 210 | 235 | 210 | 345 | 405 | 475 | 258 | 235 | 199 |
| 4 | 272 | 345 | 235 | 210 | 230 | 225 | 375 | 405 | 515 | 258 | 212 | 183 |
| 5 | 285 | 375 | 250 | 210 | 230 | 235 | 375 | 445 | 535 | 272 | 285 | 190 |
| 6 | 285 | 330 | 260 | 215 | 230 | 260 | 360 | 495 | 455 | 286 | 300 | 192 |
| 7 | 285 | 315 | 285 | 215 | 225 | 285 | 405 | 1,200 | 405 | 272 | 224 | 188 |
| 8 | 285 | 330 | 315 | 220 | 225 | 375 | 550 | 1,600 | 375 | 345 | 224 | 185 |
| 9 | 285 | 315 | 330 | 220 | 230 | 420 | 565 | 1,080 | 380 | 285 | 224 | 199 |
| 10 | 285 | 315 | 360 | 225 | 235 | 845 | 660 | 550 | 610 | 285 | 224 | 205 |
| 11 | 272 | 315 | 405 | 230 | 258 | 920 | 795 | 515 | 970 | 330 | 224 | 272 |
| 12 | 285 | 315 | 405 | 230 | 285 | 1,110 | 625 | 455 | 610 | 258 | 205 | 235 |
| 13 | 285 | 285 | 390 | 235 | 455 | 1,600 | 515 | 420 | 475 | 235 | 197 | 203 |
| 14 | 272 | 285 | 390 | 240 | 640 | 1,500 | 495 | 405 | 445 | 258 | 199 | 190 |
| 15 | 285 | 300 | 405 | 245 | 515 | 1,260 | 565 | 405 | 565 | 285 | 185 | 185 |
| 16 | 285 | 315 | 375 | 250 | 272 | 3,200 | 720 | 420 | 895 | 315 | 192 | 186 |
| 17 | 285 | 300 | 345 | 255 | 246 | 3,800 | 745 | 420 | 1,050 | 258 | 224 | 192 |
| 18 | 285 | 315 | 330 | 260 | 258 | 3,300 | 795 | 390 | 595 | 235 | 224 | 190 |
| 19 | 272 | 315 | 345 | 265 | 285 | 1,080 | 745 | 330 | 495 | 246 | 212 | 235 |
| 20 | 272 | 315 | 345 | 275 | 258 | 640 | 610 | 330 | 465 | 224 | 197 | 272 |
| 21 | 285 | 315 | 375 | 285 | 285 | 580 | 580 | 315 | 435 | 212 | 550 | 345 |
| 22 | 285 | 300 | 420 | 345 | 285 | 515 | 515 | 330 | 390 | 210 | 315 | 435 |
| 23 | 300 | 285 | 445 | 315 | 285 | 465 | 445 | 360 | 360 | 203 | 235 | 258 |
| 24 | 300 | 258 | 375 | 315 | 285 | 445 | 445 | 495 | 345 | 210 | 205 | 212 |
| 25 | 300 | 235 | 212 | 315 | 258 | 465 | 420 | 375 | 565 | 199 | 210 | 190 |
| 26 | 285 | 235 | 215 | 345 | 212 | 475 | 375 | 330 | 515 | 199 | 203 | 186 |
| 27 | 360 | 230 | 215 | 315 | 215 | 475 | 360 | 300 | 360 | 201 | 188 | 190 |
| 28 | 515 | 230 | 215 | 315 | 210 | 445 | 375 | 300 | 315 | 199 | 188 | 190 |
| 29 | 465 | 225 | 215 | 258 | ..... | 405 | 360 | 300 | 300 | 190 | 192 | 1,020 |
| 30 | 360 | 225 | 210 | 272 | ..... | 405 | 375 | 285 | 285 | 224 | 185 | 970 |
| 31 | 345 | ..... | 210 | 285 | ..... | 420 | ..... | 272 | ..... | 515 | 203 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 455 | 1,110 | 260 | 210 | 225 | 245 | 770 | 495 | 330 | 2,200 | 300 | 330 |
| 2 | 360 | 640 | 260 | 160 | 225 | 245 | 1,360 | 475 | 330 | 920 | 330 | 300 |
| 3 | 330 | 445 | 270 | 165 | 270 | 245 | 1,230 | 445 | 300 | 595 | 300 | 315 |
| 4 | 535 | 405 | 285 | 150 | 285 | 245 | 970 | 435 | 285 | 565 | 375 | 315 |
| 5 | 495 | 375 | 315 | 140 | 330 | 245 | 720 | 375 | 285 | 535 | 420 | 315 |
| 6 | 405 | 345 | 315 | 175 | 360 | 245 | 625 | 300 | 272 | 550 | 375 | 345 |
| 7 | 315 | 315 | 315 | 210 | 345 | 260 | 610 | 300 | 300 | 580 | 420 | 330 |
| 8 | 285 | 315 | 315 | 210 | 360 | 260 | 580 | 285 | 420 | 680 | 420 | 315 |
| 9 | 258 | 330 | 315 | 225 | 375 | 260 | 550 | 272 | 345 | 550 | 595 | 445 |
| 10 | 285 | 1,360 | 315 | 200 | 390 | 285 | 535 | 330 | 390 | 515 | 475 | 465 |
| 11 | 345 | 1,710 | 315 | 200 | 360 | 330 | 550 | 445 | 330 | 535 | 375 | 420 |
| 12 | 285 | 1,780 | 315 | 210 | 315 | 375 | 550 | 445 | 258 | 515 | 375 | 345 |
| 13 | 246 | 660 | 315 | 245 | 300 | 435 | 535 | 360 | 224 | 475 | 375 | 345 |
| 14 | 258 | 495 | 315 | 235 | 210 | 475 | 515 | 300 | 920 | 475 | 375 | 300 |
| 15 | 235 | 405 | 315 | 210 | 300 | 515 | 515 | 272 | 1,390 | 445 | 345 | 315 |
| 16 | 235 | 455 | 300 | 195 | 270 | 550 | 495 | 272 | 2,480 | 435 | 345 | 595 |
| 17 | 235 | 455 | 300 | 210 | 270 | 580 | 475 | 272 | 2,640 | 405 | 315 | 475 |
| 18 | 235 | 435 | 300 | 210 | 285 | 610 | 465 | 300 | 2,950 | 420 | 300 | 345 |
| 19 | 235 | 405 | 300 | 205 | 285 | 625 | 475 | 300 | 2,320 | 390 | 315 | 330 |
| 20 | 235 | 375 | 300 | 245 | 285 | 645 | 845 | 420 | 795 | 390 | 315 | 285 |
| 21 | 235 | 375 | 300 | 235 | 285 | 845 | 845 | 345 | 640 | 435 | 345 | 315 |
| 22 | 235 | 390 | 295 | 225 | 270 | 845 | 625 | 315 | 920 | 375 | 330 | 315 |
| 23 | 224 | 375 | 315 | 210 | 270 | 845 | 595 | 1,530 | 625 | 345 | 330 | 315 |
| 24 | 235 | 375 | 285 | 260 | 300 | 970 | 595 | 1,960 | 580 | 345 | 315 | 300 |
| 25 | 258 | 360 | 245 | 235 | 270 | 995 | 550 | 1,050 | 495 | 345 | 285 | 300 |
| 26 | 315 | 315 | 270 | 245 | 245 | 1,560 | 515 | 550 | 495 | 345 | 285 | 300 |
| 27 | 330 | 285 | 285 | 260 | 245 | 1,880 | 535 | 465 | 465 | 360 | 272 | 300 |
| 28 | 258 | 272 | 260 | 210 | 245 | 1,740 | 550 | 390 | 455 | 345 | 285 | 285 |
| 29 | 258 | 315 | 235 | 210 | 245 | 1,050 | 535 | 360 | 1,460 | 330 | 515 | 300 |
| 30 | 300 | 246 | 260 | 210 | ..... | 870 | 515 | 330 | 2,560 | 330 | 565 | 285 |
| 31 | 1,020 | ..... | 270 | 195 | ..... | 680 | ..... | 315 | ..... | 315 | 405 | ..... |

NOTE.—Discharge interpolated, Oct. 16, 1918, on account of lack of gage readings.

*Monthly discharge of Kickapoo River at Gays Mills, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 629 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 515 | 272 | 303 | 0.482 | 0.56 |
| November | 375 | 225 | 296 | .471 | .53 |
| December | 445 | 210 | 308 | .490 | .56 |
| January | 345 | 210 | 258 | .410 | .47 |
| February | 640 | 210 | 279 | .444 | .46 |
| March | 3,800 | 210 | 864 | 1.37 | 1.58 |
| April | 795 | 345 | 508 | .808 | .90 |
| May | 1,600 | 272 | 475 | .755 | .87 |
| June | 1,050 | 285 | 496 | .789 | .88 |
| July | 515 | 190 | 258 | .410 | .47 |
| August | 580 | 185 | 242 | .385 | .44 |
| September | 1,020 | 183 | 271 | .431 | .48 |
| The year | 3,800 | 183 | 381 | .606 | 8.20 |
| 1919–20. | | | | | |
| October | 1,020 | 224 | 320 | .509 | .59 |
| November | 1,780 | 246 | 537 | .854 | .95 |
| December | 315 | 235 | 292 | .463 | .53 |
| January | 260 | 140 | 210 | .334 | .39 |
| February | 390 | 210 | 290 | .461 | .50 |
| March | 1,880 | 245 | 644 | 1.02 | 1.18 |
| April | 1,360 | 465 | 641 | 1.02 | 1.14 |
| May | 1,960 | 272 | 474 | .754 | .87 |
| June | 2,950 | 224 | 875 | 1.39 | 1.55 |
| July | 2,200 | 315 | 518 | .824 | .95 |
| August | 595 | 272 | 367 | .583 | .67 |
| September | 595 | 285 | 342 | .544 | .61 |
| The year | 2,950 | 140 | 459 | .730 | 9.93 |

*Days of deficiency in discharge of Kickapoo River at Gays Mills, Wis., for the years ending Sept. 30, 1915-1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 140 | 0 | ..... | 0 | ..... | ..... | 0 | 0 | 0.0 |
| 160 | 11 | ..... | 1 | ..... | ..... | 2 | 14 | .6 |
| 180 | 11 | 0 | 3 | ..... | 0 | 5 | 19 | .9 |
| 200 | 11 | 2 | 8 | ..... | 29 | 7 | 57 | 2.6 |
| 230 | 35 | 5 | 17 | 0 | 94 | 28 | 179 | 8.2 |
| 260 | 101 | 7 | 43 | 21 | 132 | 63 | 367 | 16.7 |
| 300 | 201 | 65 | 105 | 99 | 198 | 111 | 779 | 35.5 |
| 340 | 239 | 146 | 128 | 134 | 231 | 190 | 1,068 | 48.7 |
| 380 | 264 | 200 | 187 | 202 | 265 | 229 | 1,347 | 61.5 |
| 420 | 268 | 246 | 215 | 248 | 289 | 242 | 1,508 | 68.8 |
| 460 | 279 | 266 | 242 | 273 | 302 | 264 | 1,626 | 74.2 |
| 500 | 295 | 288 | 265 | 288 | 314 | 282 | 1,732 | 79.0 |
| 550 | 320 | 320 | 293 | 306 | 327 | 297 | 1,863 | 85.0 |
| 700 | 338 | 332 | 325 | 324 | 342 | 329 | 1,990 | 90.8 |
| 900 | 342 | 338 | 339 | 334 | 349 | 338 | 2,040 | 93.1 |
| 1,200 | 363 | 354 | 347 | 343 | 358 | 348 | 2,113 | 96.4 |
| 1,600 | 363 | 359 | 352 | 351 | 362 | 355 | 2,142 | 97.7 |
| 2,000 | 365 | 362 | 355 | 355 | 362 | 360 | 2,159 | 98.5 |
| 3,000 | ..... | 364 | 360 | 365 | 362 | 366 | 2,182 | 99.5 |
| 4,000 | ..... | 366 | 364 | ..... | 365 | ..... | 2,191 | 100.0 |
| 6,000 | ..... | ..... | 365 | ..... | ..... | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 380 | 468 | 514 | 494 | 381 | 459 | ..... | ..... |
| Maximum (sec.-ft.) | 1,760 | 3,360 | 4,740 | 2,740 | 3,800 | 2,950 | ..... | ..... |
| Minimum (sec.-ft.) | a155 | 190 | 160 | 245 | 183 | 140 | ..... | ..... |

a Approximate.

### TURKEY RIVER AT GARBER, IOWA.

LOCATION.—In sec. 36, T. 92 N., R. 4 W., at single-span highway bridge at Garber, Clayton County, 800 feet above mouth of Wayne Creek, which enters from right, and 1 mile below mouth of Volga River, which enters from right.

DRAINAGE AREA.—1,530 square miles (measured on map issued by United States Geological Survey; scale 1 to 500,000).

RECORDS AVAILABLE.—August 29, 1913, to November 30, 1916; May 14, 1919, to September 30, 1920.

GAGE.—Chain gage attached to handrail on downstream side of bridge; read by E. J. Prolow.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and mud; shifting. Low-water control is a gravel bar. Right bank high; left bank subject to overflow at extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year ending September 30, 1919, 16.47 feet at 7 a. m. June 4 (discharge, 13,100 second-feet); minimum stage, 3.50 feet August 30 to September 9 (discharge, 250 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.41 feet at 8 a. m. March 12 (discharge, 10,500 second-feet); minimum stage, 3.61 feet at 6 p. m. August 19 (discharge, 334 second-feet).

1913–1916; 1919 and 1920: Maximum stage recorded, 22.0 feet June 3, 1916 (discharge, about 20,300 second-feet); minimum stage, 2.70 feet September 5 and 7, 1913 (discharge, 100 second-feet).

The highest stage within the last 30 years probably occurred May 18, 1902, when a stage of about 23.7 feet referred to gage datum was reached, as indicated by high-water marks on A. F. Grafe's residence in Garber.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued.

REGULATION.—Operation of an electric light plant and grist mill at Elkader about 15 miles upstream may cause slight diurnal fluctuation at gage.

ACCURACY.—Stage-discharge relation changed several times during period of record. Four fairly well-defined rating curves used as follows: August 29, 1913, to January 29, 1914, and June 16, 1914, to August 5, 1915; January 30 to June 15, 1914; August 6, 1915, to June 4, 1916, and May 14, 1919, to September 30, 1920; June 5 to November 29, 1916. Gage read to quarter-tenths twice daily during 1913 and 1914, and to hundredths once daily beginning March 31, 1915. Daily discharge ascertained by applying mean daily or daily gage height to rating table except for periods June 5 to September 10, 1919, and August 22 to September 30, 1920, for which it was ascertained by means of the indirect method for shifting control. Records subject to error on account of uncertainty in determining time of changes in stage-discharge relation, and also because of fact that other changes may have occurred which are indeterminate on account of lack of discharge measurements.

*Discharge measurements of Turkey River at Garber, Iowa, during the years ending Sept. 30, 1919 and 1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| 1919. | *Feet.* | *Sec.-ft.* | 1920. | *Feet.* | *Sec.-ft.* |
| May 14 | 4.94 | 1,040 | Apr. 14 | 5.22 | 1,210 |
| July 24 | 3.96 | 398 | June 22 | 4.80 | 946 |
| Sept. 24 | 4.26 | 599 | Aug. 30 | 3.96 | 413 |

*Daily discharge, in second-feet, of Turkey River at Garber, Iowa, for the years ending Sept. 30, 1913–1917 and 1919 and 1920.*

| Day. | Aug. | Sept. | Day. | Aug. | Sept. | Day. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1913. | | | 1913. | | | 1913. | | |
| 1 | | 160 | 11 | | 305 | 21 | | 390 |
| 2 | | 160 | 12 | | 190 | 22 | | 265 |
| 3 | | 130 | 13 | | 160 | 23 | | 190 |
| 4 | | 115 | 14 | | 160 | 24 | | 175 |
| 5 | | 100 | 15 | | 160 | 25 | | 175 |
| 6 | | 115 | 16 | | 265 | 26 | | 225 |
| 7 | | 100 | 17 | | 175 | 27 | | 190 |
| 8 | | 575 | 18 | | 130 | 28 | | 175 |
| 9 | | 190 | 19 | | 130 | 29 | 160 | 160 |
| 10 | | 130 | 20 | | 680 | 30 | 160 | 265 |
| | | | | | | 31 | 160 | |

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1913–14. | | | | | | | | | | | | |
| 1 | 480 | 208 | 305 | | 1,010 | | 945 | 825 | 688 | 795 | 285 | 680 |
| 2 | 325 | 225 | 325 | | 515 | | 825 | 635 | 560 | 735 | 245 | 265 |
| 3 | 265 | 208 | 325 | | 560 | | 715 | 585 | 515 | 625 | 225 | 225 |
| 4 | 208 | 225 | 305 | | 425 | | 610 | 885 | 470 | 550 | 208 | 208 |
| 5 | 680 | 208 | 305 | | 515 | | 470 | 825 | 885 | 575 | 245 | 208 |
| 6 | 305 | 208 | 305 | | 1,080 | | 425 | 635 | 1,350 | 525 | 245 | 160 |
| 7 | 265 | 208 | 325 | | | | 470 | 538 | 1,950 | 600 | 208 | 145 |
| 8 | 285 | 208 | 208 | | | | 402 | 448 | 1,420 | 625 | 190 | 145 |
| 9 | 265 | 208 | 245 | | | | 360 | 448 | 1,080 | 435 | 160 | 130 |
| 10 | 480 | 208 | 265 | | | | 260 | 425 | 825 | 435 | 160 | 160 |
| 11 | 1,370 | 190 | 265 | | | | 340 | 585 | 715 | 412 | 190 | 190 |
| 12 | 735 | 208 | 265 | | | 770 | 320 | 538 | 660 | 368 | 175 | 160 |
| 13 | 625 | 208 | 285 | | | 770 | 300 | 585 | 770 | 458 | 175 | 245 |
| 14 | 480 | 208 | 285 | | | 770 | 300 | 560 | 6,510 | 368 | 160 | 1,660 |
| 15 | 390 | 208 | 285 | | | 660 | 300 | 516 | 8,600 | 345 | 175 | 1,510 |
| 16 | 345 | 208 | 265 | | | 610 | 300 | 492 | 4,400 | 390 | 208 | 855 |
| 17 | 345 | 190 | 265 | | | 470 | 260 | 448 | 2,220 | 412 | 160 | 625 |
| 18 | 305 | 190 | 265 | | | 360 | 280 | 425 | 1,580 | 412 | 190 | 575 |
| 19 | 265 | 245 | 265 | | | 360 | 320 | 380 | 1,660 | 345 | 600 | 480 |
| 20 | 265 | 265 | 245 | | | 340 | 402 | 380 | 1,300 | 345 | 525 | 390 |
| 21 | 265 | 265 | | | | 340 | 380 | 320 | 1,660 | 325 | 305 | 368 |
| 22 | 265 | 265 | | | | 320 | 320 | 360 | 3,010 | 305 | 190 | 625 |
| 23 | 245 | 265 | | | | 300 | 320 | 360 | 1,980 | 285 | 208 | 680 |
| 24 | 225 | 265 | | | | 280 | 300 | 1,640 | 1,370 | 625 | 175 | 575 |
| 25 | 225 | 245 | | | | 280 | 340 | 1,950 | 1,040 | 915 | 225 | 480 |
| 26 | 225 | 225 | | | | 340 | 380 | 4,070 | 1,370 | 680 | 190 | 412 |
| 27 | 208 | 225 | | | | 360 | 402 | 1,870 | 1,040 | 458 | 160 | 325 |
| 28 | 190 | 225 | | | | 610 | 610 | 1,350 | 795 | 390 | 160 | 325 |
| 29 | 245 | 245 | | | | 885 | 1,280 | 1,280 | 680 | 325 | 175 | 325 |
| 30 | 245 | 285 | | 1,790 | | 1,010 | 1,080 | 945 | 680 | 285 | 175 | 325 |
| 31 | 225 | | | 1,140 | | 1,080 | | 715 | | 305 | 160 | |

*Daily discharge, in second-feet, of Turkey River at Garber, Iowa, for the years ending Sept. 30, 1913–1917 and 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1915. | | | | | | | | | | | | |
| 1 | | | | | | | 1,660 | 680 | 3,280 | 1,240 | 4,890 | 505 |
| 2 | | | | | | | 1,510 | 795 | 2,380 | 975 | 8,920 | 505 |
| 3 | | | | | | | 1,510 | 1,240 | 1,820 | 3,190 | 8,920 | 482 |
| 4 | | | | | | | 1,370 | 2,830 | 1,510 | 975 | 10,600 | 482 |
| 5 | | | | | | | 1,740 | 1,900 | 1,300 | 1,100 | 8,340 | 482 |
| 6 | | | | | | | 2,060 | 1,820 | 1,240 | 975 | 3,700 | 482 |
| 7 | | | | | | | 2,140 | 1,660 | 1,170 | 855 | 2,610 | 482 |
| 8 | | | | | | | 1,980 | 1,900 | 975 | 1,240 | 2,030 | 505 |
| 9 | | | | | | | 1,660 | 1,370 | 975 | 1,660 | 1,550 | 550 |
| 10 | | | | | | | 1,660 | 1,170 | 975 | 1,240 | 1,400 | 505 |
| 11 | | | | | | | 1,660 | 975 | 915 | 1,240 | 1,260 | 505 |
| 12 | | | | | | | 1,510 | 915 | 855 | 1,100 | 1,060 | 505 |
| 13 | | | | | | | 1,300 | 795 | 1,510 | 855 | 940 | 1,630 |
| 14 | | | | | | | 1,170 | 735 | 1,370 | 975 | 1,330 | 1,060 |
| 15 | | | | | | | 1,040 | 735 | 1,100 | 975 | 1,260 | 940 |
| 16 | | | | | | | 975 | 680 | 1,240 | 975 | 1,060 | 1,710 |
| 17 | | | | | | | 915 | 600 | 1,040 | 1,100 | 940 | 1,470 |
| 18 | | | | | | | 855 | 600 | 1,740 | 2,140 | 940 | 940 |
| 19 | | | | | | | 855 | 625 | 1,370 | 2,140 | 820 | 700 |
| 20 | | | | | | | 795 | 735 | 1,240 | 1,980 | 760 | 1,120 |
| 21 | | | | | | | 680 | 1,170 | 1,370 | 1,510 | 700 | 880 |
| 22 | | | | | | | 680 | 1,370 | 1,300 | 1,440 | 700 | 700 |
| 23 | | | | | | | 625 | 1,510 | 680 | 2,300 | 700 | 650 |
| 24 | | | | | | | 625 | 1,510 | 855 | 2,380 | 650 | 600 |
| 25 | | | | | | | 575 | 3,640 | 855 | 4,300 | 650 | 550 |
| 26 | | | | | | | 550 | 3,550 | 735 | 3,460 | 600 | 4,270 |
| 27 | | | | | | | 525 | 1,820 | 975 | 2,300 | 600 | 2,350 |
| 28 | | | | | | | 600 | 1,820 | 1,100 | 1,240 | 550 | 1,870 |
| 29 | | | | | | | 735 | 5,310 | 1,100 | 1,100 | 550 | 1,120 |
| 30 | | | | | | | 735 | 6,570 | 1,100 | 1,370 | 550 | 940 |
| 31 | | | | | | | | 4,780 | | 4,890 | 505 | |
| 1915–16. | | | | | | | | | | | | |
| 1 | 820 | 438 | 550 | | | | 1,630 | 1,190 | 700 | 720 | 370 | 272 |
| 2 | 760 | 415 | 550 | | | | 1,550 | 1,260 | 16,300 | 775 | 290 | 255 |
| 3 | 760 | 415 | 505 | | | | 1,400 | 1,060 | 16,800 | 748 | 255 | 255 |
| 4 | 1,260 | 392 | 505 | | | | 1,260 | 940 | 8,120 | 748 | 535 | 510 |
| 5 | 940 | 392 | 460 | | | | 1,120 | 760 | 3,210 | 720 | 560 | 202 |
| 6 | 760 | 392 | 460 | | | | 1,060 | 760 | 1,880 | 692 | 510 | 202 |
| 7 | 650 | 392 | 460 | | | | 1,000 | 700 | 1,580 | 638 | 485 | 748 |
| 8 | 600 | 392 | 460 | | | | 880 | 650 | 1,800 | 585 | 438 | 485 |
| 9 | 550 | 370 | 438 | | | | 1,260 | 650 | 1,580 | 560 | 370 | 392 |
| 10 | 550 | 392 | 438 | | | | 850 | 625 | 1,430 | 535 | 392 | 350 |
| 11 | 550 | 4,980 | 438 | | | | 790 | 550 | 1,290 | 535 | 438 | 310 |
| 12 | 505 | 2,790 | 438 | | | | 730 | 438 | 1,150 | 535 | 350 | 330 |
| 13 | 550 | 1,710 | 438 | | | | 700 | 438 | 1,080 | 955 | 330 | 350 |
| 14 | 600 | 1,400 | 438 | | | | 760 | 2,190 | 1,150 | 748 | 310 | 350 |
| 15 | 600 | 1,120 | 438 | | | 760 | 675 | 2,700 | 1,020 | 720 | 350 | 350 |
| 16 | 650 | 940 | 460 | | | 760 | 850 | 2,110 | 1,020 | 748 | 350 | 350 |
| 17 | 820 | 880 | 460 | | | 700 | 880 | 1,710 | 1,080 | 692 | 310 | 330 |
| 18 | 1,060 | 820 | | | | 650 | 940 | 1,330 | 1,020 | 692 | 310 | 310 |
| 19 | 1,120 | 760 | | | | 600 | 1,060 | 1,120 | 895 | 585 | 310 | 272 |
| 20 | 1,000 | 650 | | | | 550 | 1,000 | 850 | 895 | 535 | 310 | 255 |
| 21 | 820 | 600 | | | | 482 | 3,890 | 790 | 895 | 485 | 290 | 255 |
| 22 | 700 | 550 | | | | 2,190 | 3,060 | 1,120 | 805 | 485 | 272 | 255 |
| 23 | 650 | 550 | | | | 1,470 | 2,790 | 1,550 | 1,020 | 535 | 272 | 255 |
| 24 | 600 | 820 | | | | 8,000 | 1,630 | 1,330 | 835 | 415 | 255 | 255 |
| 25 | 550 | 600 | | | | 17,200 | 940 | 1,260 | 748 | 535 | 255 | 255 |
| 26 | 505 | 600 | | | | 14,800 | 850 | 1,000 | 2,220 | 535 | 238 | 272 |
| 27 | 482 | 600 | | | | 6,460 | 790 | 850 | 1,650 | 560 | 238 | 585 |
| 28 | 460 | 600 | | | | 3,060 | 760 | 760 | 955 | 510 | 238 | 510 |
| 29 | 460 | 600 | | | | 1,950 | 790 | 700 | 775 | 485 | 238 | 392 |
| 30 | 438 | 600 | | | | 1,630 | 910 | 700 | 748 | 438 | 238 | 370 |
| 31 | 438 | | | | | 1,550 | | 760 | | 392 | 290 | |

*Daily discharge, in second-feet, of Turkey River at Garber, Iowa, for the years ending Sept. 30, 1913-1917 and 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Day. | Oct. | Nov. | Day. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| 1916. | | | 1916. | | | 1916. | | |
| 1 | 392 | 310 | 11 | 255 | 350 | 21 | 330 | 370 |
| 2 | 370 | 290 | 12 | 255 | 330 | 22 | 310 | 340 |
| 3 | 310 | 272 | 13 | 255 | 330 | 23 | 330 | 310 |
| 4 | 310 | 272 | 14 | 255 | 415 | 24 | 370 | 330 |
| 5 | 290 | 272 | 15 | 255 | 415 | 25 | 370 | 310 |
| 6 | 290 | 370 | 16 | 255 | 415 | 26 | 370 | 310 |
| 7 | 272 | 370 | 17 | 255 | 415 | 27 | 415 | 310 |
| 8 | 238 | 350 | 18 | 255 | 415 | 28 | 460 | 310 |
| 9 | 220 | 350 | 19 | 255 | 415 | 29 | 415 | 310 |
| 10 | 220 | 350 | 20 | 350 | 370 | 30 | 370 | 290 |
| | | | | | | 31 | 370 | ..... |

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | 1919. | | | | | |
| 1 | ..... | 575 | 730 | 1,060 | 250 | 16 | 820 | 2,610 | 482 | 460 | 310 |
| 2 | ..... | 1,260 | 625 | 460 | 250 | 17 | 730 | 1,870 | 575 | 460 | 330 |
| 3 | ..... | 1,330 | 600 | 438 | 250 | 18 | 700 | 1,790 | 575 | 460 | 330 |
| 4 | ..... | 7,000 | 575 | 415 | 250 | 19 | 730 | 1,790 | 505 | 460 | 1,400 |
| 5 | ..... | 2,610 | 575 | 528 | 250 | 20 | 730 | 1,260 | 460 | 460 | 370 |
| 6 | ..... | 2,790 | 528 | 415 | 250 | 21 | 675 | 2,700 | 415 | 460 | 415 |
| 7 | ..... | 2,110 | 505 | 330 | 250 | 22 | 650 | 2,700 | 438 | 460 | 350 |
| 8 | ..... | 1,630 | 438 | 415 | 250 | 23 | 760 | 1,630 | 392 | 438 | 330 |
| 9 | ..... | 1,260 | 1,790 | 415 | 250 | 24 | 730 | 1,330 | 370 | 370 | 330 |
| 10 | ..... | 1,950 | 1,120 | 415 | 1,060 | 25 | 650 | 2,030 | 370 | 330 | 330 |
| 11 | ..... | 2,880 | 650 | 415 | 370 | 26 | 650 | 1,790 | 330 | 290 | 310 |
| 12 | ..... | 3,510 | 550 | 415 | 415 | 27 | 625 | 1,630 | 330 | 290 | 310 |
| 13 | ..... | 2,970 | 460 | 1,550 | 370 | 28 | 625 | 1,060 | 392 | 290 | 330 |
| 14 | 940 | 2,110 | 460 | 675 | 370 | 29 | 575 | 820 | 350 | 270 | 350 |
| 15 | 880 | 1,630 | 460 | 460 | 330 | 30 | 575 | 820 | 370 | 250 | 392 |
| | | | | | | 31 | 575 | ..... | 1,710 | 250 | ..... |

| Day. | Oct. | Nov. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | |
| 1 | 700 | 820 | ..... | 5,300 | 1,710 | 2,610 | 730 | 392 | 370 |
| 2 | 600 | 700 | ..... | 3,700 | 2,350 | 1,190 | 730 | 460 | 350 |
| 3 | 820 | 625 | ..... | 3,240 | 2,350 | 940 | 880 | 415 | 370 |
| 4 | 1,550 | 550 | ..... | 2,700 | 2,110 | 940 | 700 | 415 | 350 |
| 5 | 820 | 550 | ..... | 2,110 | 1,870 | 880 | 760 | 438 | 392 |
| 6 | 650 | 550 | ..... | 1,870 | 1,550 | 820 | 700 | 482 | 438 |
| 7 | 600 | 528 | ..... | 1,630 | 1,400 | 760 | 820 | 1,000 | 415 |
| 8 | 482 | 505 | ..... | 1,470 | 1,190 | 760 | 1,710 | 600 | 2,110 |
| 9 | 415 | 700 | ..... | 1,400 | 1,000 | 730 | 940 | 460 | 2,110 |
| 10 | 415 | 4,880 | ..... | 1,330 | 880 | 730 | 820 | 460 | 880 |
| 11 | 370 | 3,420 | ..... | 1,330 | 2,880 | 700 | 880 | 392 | 1,000 |
| 12 | 370 | 2,790 | 8,700 | 1,260 | 4,880 | 700 | 820 | 482 | 760 |
| 13 | 370 | 2,430 | 3,240 | 1,190 | 4,180 | 760 | 730 | 438 | 600 |
| 14 | 370 | 1,950 | 3,150 | 1,120 | 2,270 | 700 | 675 | 438 | 528 |
| 15 | 370 | 1,260 | 3,700 | 1,060 | 1,870 | 880 | 625 | 438 | 1,120 |
| 16 | 370 | 700 | 3,240 | 1,000 | 1,550 | 820 | 550 | 415 | 675 |
| 17 | 370 | 1,000 | 2,970 | 940 | 1,400 | 1,400 | 550 | 415 | 675 |
| 18 | 370 | 940 | 2,790 | 940 | 1,330 | 1,060 | 575 | 392 | 505 |
| 19 | 370 | 940 | 2,430 | 1,000 | 1,260 | 1,000 | 575 | 370 | 482 |
| 20 | 370 | 880 | 2,110 | 5,090 | 1,190 | 880 | 528 | 1,060 | 460 |
| 21 | 370 | 880 | 1,870 | 4,080 | 1,120 | 1,000 | 528 | 2,970 | 460 |
| 22 | 370 | 880 | 1,870 | 3,700 | 1,120 | 880 | 505 | 820 | 392 |
| 23 | 370 | 760 | 1,870 | 3,330 | 2,270 | 820 | 482 | 528 | 392 |
| 24 | 370 | 700 | 1,950 | 2,610 | 4,080 | 760 | 460 | 460 | 392 |
| 25 | 370 | 700 | 2,880 | 2,270 | 2,610 | 675 | 460 | 438 | 370 |
| 26 | 370 | 700 | 6,140 | 2,110 | 2,270 | 675 | 482 | 392 | 392 |
| 27 | 370 | 700 | 5,720 | 2,030 | 1,870 | 625 | 482 | 370 | 392 |
| 28 | 370 | 700 | 6,560 | 2,030 | 1,470 | 820 | 482 | 350 | 370 |
| 29 | 370 | 650 | 5,400 | 1,950 | 1,120 | 940 | 460 | 392 | 370 |
| 30 | 370 | 650 | 4,880 | 1,870 | 820 | 820 | 460 | 438 | 370 |
| 31 | 370 | ..... | 4,670 | ..... | 700 | ..... | 460 | 392 | ..... |

NOTE.—Discharge interpolated Nov. 22, 1916, on account of lack of gage reading. Discharge estimated because of ice, Nov. 30, 1916, and Nov. 29 and 30, 1919. Observations discontinued during periods for which no discharge is given. Stage-discharge relation changed Jan. 29, June 15, 1914, Aug. 5, 1915, June 4, 1916, and on an unknown date between June 5, 1916, and May 14, 1919; gradual changes occurred during the periods June 5 to Sept. 10, 1919, and Aug. 22 to Sept. 30, 1920.

*Monthly discharge of Turkey River at Garber, Iowa, for the years ending Sept. 30, 1913–1917 and 1919 and 1920.*

[Drainage area, 1,530 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1913. | | | | | |
| September | 680 | 100 | 211 | 0.138 | 0.15 |
| 1913–14. | | | | | |
| October | 1,370 | 190 | 363 | .237 | .27 |
| November | 285 | 190 | 225 | .147 | .16 |
| December 1–20 | | | 280 | .183 | .14 |
| March 12–31 | | | 546 | .357 | .27 |
| April | 1,280 | 260 | 467 | .305 | .34 |
| May | 4,070 | 320 | 839 | .548 | .63 |
| June | 8,600 | 470 | 1,730 | 1.13 | 1.26 |
| July | 915 | 285 | 473 | .309 | .36 |
| August | 600 | 160 | 221 | .144 | .17 |
| September | 1,660 | 130 | 449 | .293 | .33 |
| 1915. | | | | | |
| April | 2,140 | 525 | 1,160 | .758 | .85 |
| May | 6,570 | 600 | 1,800 | 1.18 | 1.36 |
| June | 3,280 | 680 | 1,270 | .830 | .93 |
| July | 4,890 | 855 | 1,720 | 1.12 | 1.29 |
| August | 10,600 | 505 | 2,260 | 1.48 | 1.71 |
| September | 4,270 | 482 | 983 | .642 | .72 |
| 1915–16. | | | | | |
| October | 1,260 | 438 | 684 | .447 | .52 |
| November | 4,980 | 370 | 872 | .570 | .64 |
| December 1–17 | | | 467 | .305 | .19 |
| March 15–31 | 17,200 | | 3,690 | 2.41 | 1.52 |
| April | 3,890 | 675 | 1,230 | .804 | .90 |
| May | 2,700 | 438 | 1,060 | .693 | .80 |
| June | 16,800 | 700 | 2,490 | 1.63 | 1.82 |
| July | 955 | 392 | 608 | .397 | .46 |
| August | 560 | 238 | 335 | .219 | .25 |
| September | 748 | 202 | 343 | .224 | .25 |
| 1916. | | | | | |
| October | 460 | 220 | 312 | .204 | .24 |
| November | 415 | 272 | 342 | .224 | .25 |
| 1919. | | | | | |
| May 14–31 | | | 701 | .458 | .31 |
| June | 7,000 | 575 | 2,050 | 1.34 | 1.50 |
| July | 1,790 | 330 | 585 | .382 | .44 |
| August | 1,550 | 250 | 465 | .304 | .35 |
| September | 1,400 | 250 | 378 | .247 | .28 |
| 1919–20. | | | | | |
| October | 1,550 | 370 | 478 | .312 | .36 |
| November | 4,880 | 505 | 1,130 | .739 | .82 |
| March 12–31 | | | 3,810 | 2.49 | 1.85 |
| April | 5,300 | 940 | 2,190 | 1.43 | 1.60 |
| May | 4,880 | 700 | 1,890 | 1.24 | 1.43 |
| June | 2,610 | 625 | 909 | .594 | .66 |
| July | 1,710 | 460 | 663 | .433 | .50 |
| August | 2,970 | 350 | 565 | .369 | .43 |
| September | 2,110 | 350 | 616 | .403 | .45 |

### MAQUOKETA RIVER BELOW NORTH FORK OF MAQUOKETA RIVER, NEAR MAQUOKETA, IOWA.

LOCATION.—In southwest corner NE. ¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, 1.200 feet above mouth of Mill Creek, 2 miles below mouth of North Fork of Maquoketa River and 3 miles northeast of Maquoketa, Jackson County.

DRAINAGE AREA.—1,600 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000). Drainage area at mouth, 1,960 square miles.

RECORDS AVAILABLE.—September 1, 1913, to September 30, 1920.

GAGE.—Chain gage attached to downstream handrail of bridge, 100 feet from right abutment; read by John Strodtheff.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed of stream composed of sand; shifts during high water. Two channels at stages below 12 feet; above 12 feet there is overflow under pile trestle approach at left end of bridge. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 16.57 feet at 8.30 a. m. March 17 (discharge, 11,400 second-feet); minimum stage, 1.59 feet at 9.30 a. m. December 25 (discharge, about 245 second-feet); this stage occurred just prior to freezing over of river.

Maximum stage recorded during year ending September 30, 1920, 14.72 feet at 12.45 a. m. November 12 (discharge, 9,150 second-feet); minimum stage, 2.33 feet at 7.30 a. m. September 29 (discharge, 444 second-feet).

1913–1920: Maximum stage recorded, 22.0 feet March 27, 1916 (discharge, 21,300 second-feet); minimum stage, 1.59 feet December 25, 1918 (discharge, about 245 second-feet).

A stage of about 23.5 feet (discharge, about 24,300 second-feet) occurred prior to 1913, probably in 1905.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed during flood of May 22–26, 1920; affected by ice December 26, 1918, to January 27, 1919, February 9 and 10, March 1-9, 1919, and December 9, 1919, to March 3, 1920. Rating curve used October 1, 1918, to May 23, 1920, well defined throughout; curve used May 24 to September 30, 1920, is a revision of former curve below gage height 5.0 feet (discharge, 1,920 second-feet) and is well defined above 2,000 second-feet and fairly well defined below. Gage read to hundredths once daily except during period of ice effect in 1920. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| 1918. | | | | 1919. | | | |
| Oct. 10 | H. C. Beckman..... | 1.85 | 332 | July 22 | E. D. Burchard..... | 2.81 | 719 |
| | | | | Sept. 11 | .....do..... | 2.98 | 819 |
| 1919. | | | | 1920. | | | |
| Mar. 22 | R. H. Bolster..... | 4.97 | 1,920 | | | | |
| May 10 | E. D. Burchard..... | 5.89 | 2,510 | May 26 | .....do..... | 5.10 | 2,040 |

*Daily discharge, in second-feet, of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the years ending Sept. 30, 1919 and 1920*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 328 | 540 | 380 | 420 | 540 | 650 | 855 | 1,680 | 1,270 | 810 | 1,220 | 480 |
| 2 | 345 | 460 | 380 | 420 | 585 | 800 | 905 | 2,120 | 3,550 | 810 | 765 | 460 |
| 3 | 328 | 440 | 380 | 420 | 540 | 700 | 810 | 6,980 | 5,540 | 765 | 630 | 500 |
| 4 | 328 | 420 | 380 | 460 | 400 | 750 | 810 | 9,800 | 5,540 | 720 | 630 | 480 |
| 5 | 328 | 400 | 400 | 460 | 310 | 800 | 810 | 5,600 | 4,980 | 810 | 1,380 | 460 |
| 6 | 328 | 400 | 420 | 500 | 380 | 1,000 | 810 | 3,620 | 4,140 | 1,440 | 765 | 460 |
| 7 | 328 | 380 | 380 | 500 | 460 | 1,200 | 810 | 5,990 | 4,260 | 1,320 | 1,990 | 460 |
| 8 | 310 | 400 | 420 | 500 | 420 | 1,300 | 905 | 4,400 | 3,220 | 905 | 855 | 460 |
| 9 | 345 | 380 | 480 | 500 | 460 | 1,500 | 1,220 | 3,220 | 2,440 | 2,700 | 675 | 540 |
| 10 | 328 | 362 | 720 | 460 | 460 | 1,860 | 2,580 | 2,440 | 2,440 | 7,060 | 585 | 2,180 |
| 11 | 362 | 345 | 720 | 460 | 420 | 4,260 | 3,420 | 2,060 | 2,510 | 5,600 | 585 | 1,160 |
| 12 | 400 | 345 | 630 | 460 | 440 | 5,470 | 2,640 | 1,800 | 1,920 | 2,180 | 540 | 765 |
| 13 | 585 | 345 | 585 | 420 | 675 | 5,280 | 1,860 | 1,560 | 1,800 | 1,620 | 585 | 585 |
| 14 | 460 | 345 | 585 | 420 | 3,360 | 4,660 | 1,560 | 1,440 | 1,740 | 1,380 | 1,380 | 585 |
| 15 | 400 | 345 | 585 | 460 | 2,060 | 3,810 | 2,180 | 1,320 | 1,560 | 1,380 | 855 | 540 |
| 16 | 380 | 380 | 540 | 460 | 1,000 | 9,800 | 4,260 | 1,270 | 1,380 | 1,160 | 675 | 480 |
| 17 | 362 | 380 | 540 | 550 | 855 | 10,400 | 3,940 | 1,160 | 3,680 | 1,000 | 585 | 480 |
| 18 | 362 | 420 | 500 | 550 | 810 | 6,530 | 2,900 | 1,100 | 2,510 | 955 | 540 | 630 |
| 19 | 345 | 400 | 500 | 550 | 675 | 3,620 | 2,250 | 1,060 | 1,860 | 855 | 630 | 3,880 |
| 20 | 362 | 380 | 500 | 550 | 630 | 2,840 | 1,800 | 1,000 | 1,740 | 810 | 540 | 3,480 |
| 21 | 345 | 380 | 500 | 550 | 630 | 2,320 | 1,560 | 955 | 1,500 | 765 | 4,070 | 1,740 |
| 22 | 345 | 380 | 500 | 550 | 675 | 1,920 | 1,380 | 955 | 1,560 | 765 | 1,380 | 1,100 |
| 23 | 328 | 362 | 500 | 600 | 630 | 1,680 | 1,800 | 1,060 | 1,270 | 720 | 810 | 905 |
| 24 | 362 | 275 | 480 | 650 | 585 | 1,500 | 2,340 | 1,440 | 1,740 | 675 | 675 | 810 |
| 25 | 345 | 275 | 245 | 700 | 500 | 1,380 | 1,800 | 1,160 | 2,180 | 675 | 630 | 720 |
| 26 | 345 | 292 | 280 | 750 | 440 | 1,270 | 1,380 | 1,000 | 1,440 | 630 | 540 | 630 |
| 27 | 400 | 310 | 300 | 750 | 328 | 1,220 | 1,220 | 905 | 1,160 | 630 | 540 | 630 |
| 28 | 1,680 | 460 | 340 | 720 | 440 | 1,100 | 1,220 | 855 | 1,000 | 585 | 540 | 585 |
| 29 | 905 | 540 | 380 | 630 | ..... | 1,000 | 1,160 | 810 | 905 | 585 | 500 | 630 |
| 30 | 630 | 400 | 460 | 585 | ..... | 1,000 | 1,100 | 765 | 855 | 585 | 500 | 720 |
| 31 | 540 | ..... | 460 | 585 | ..... | 955 | ..... | 765 | ..... | 540 | 480 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 4,070 | 2,510 | 855 | ..... | ..... | 1,200 | 2,700 | 1,680 | 1,920 | 1,030 | 565 | 610 |
| 2 | 2,180 | 2,060 | 630 | ..... | ..... | 1,500 | 5,920 | 1,740 | 2,320 | 1,080 | 610 | 610 |
| 3 | 1,500 | 2,180 | 675 | ..... | ..... | 1,800 | 5,860 | 1,560 | 4,140 | 2,840 | 565 | 565 |
| 4 | 2,900 | 1,380 | 840 | ..... | ..... | 2,900 | 3,880 | 1,380 | 2,510 | 1,260 | 565 | 542 |
| 5 | 6,600 | 1,160 | 1,000 | ..... | ..... | 1,680 | 2,640 | 1,270 | 2,060 | 1,030 | 565 | 542 |
| 6 | 5,920 | 1,060 | 1,060 | ..... | ..... | 2,700 | 2,180 | 1,220 | 1,620 | 1,260 | 660 | 660 |
| 7 | 3,030 | 1,100 | 1,100 | ..... | ..... | 2,700 | 1,990 | 1,100 | 1,440 | 1,380 | 610 | 565 |
| 8 | 2,120 | 1,100 | 1,270 | ..... | ..... | 2,580 | 1,740 | 1,100 | 1,320 | 1,080 | 565 | 520 |
| 9 | 1,740 | 1,620 | ..... | ..... | ..... | 2,580 | 1,620 | 1,060 | 1,380 | 920 | 760 | 610 |
| 10 | 1,500 | 7,700 | ..... | ..... | ..... | 3,680 | 1,530 | 1,060 | 1,200 | 865 | 920 | 660 |
| 11 | 1,270 | 9,690 | ..... | ..... | ..... | 4,400 | 1,440 | 1,000 | 1,140 | 810 | 760 | 710 |
| 12 | 1,100 | 7,610 | ..... | ..... | ..... | 8,400 | 1,380 | 1,100 | 1,080 | 785 | 710 | 660 |
| 13 | 1,060 | 3,680 | ..... | ..... | ..... | 8,400 | 1,320 | 1,990 | 1,030 | 760 | 1,200 | 610 |
| 14 | 1,000 | 2,640 | ..... | ..... | ..... | 4,850 | 1,320 | 2,510 | 975 | 760 | 865 | 610 |
| 15 | 905 | 2,120 | ..... | ..... | ..... | 3,100 | 1,270 | 1,990 | 975 | 760 | 810 | 542 |
| 16 | 955 | 1,800 | ..... | ..... | ..... | 2,960 | 1,270 | 1,560 | 975 | 710 | 760 | 542 |
| 17 | 955 | 1,680 | ..... | ..... | ..... | 2,580 | 1,320 | 1,380 | 1,320 | 710 | 660 | 542 |
| 18 | 905 | 1,620 | ..... | ..... | ..... | 1,920 | 1,220 | 1,320 | 1,620 | 1,080 | 610 | 520 |
| 19 | 855 | 1,560 | ..... | ..... | ..... | 1,800 | 1,620 | 1,320 | 1,500 | 920 | 610 | 498 |
| 20 | 810 | 1,440 | ..... | ..... | ..... | 1,920 | 5,470 | 1,320 | 1,260 | 760 | 610 | 520 |
| 21 | 810 | 1,320 | ..... | ..... | ..... | 2,440 | 3,620 | 1,270 | 1,080 | 710 | 1,440 | 520 |
| 22 | 765 | 1,320 | ..... | ..... | ..... | 2,700 | 3,680 | 4,330 | 1,380 | 710 | 1,200 | 520 |
| 23 | 765 | 1,320 | ..... | ..... | ..... | 2,320 | 2,440 | 8,000 | 1,380 | 660 | 1,030 | 520 |
| 24 | 765 | 1,320 | ..... | ..... | ..... | 2,440 | 2,120 | 4,660 | 1,030 | 660 | 810 | 542 |
| 25 | 765 | 1,270 | ..... | ..... | ..... | 4,720 | 1,860 | 2,640 | 920 | 610 | 710 | 542 |
| 26 | 765 | 1,220 | ..... | ..... | ..... | 7,420 | 1,680 | 2,030 | 865 | 610 | 660 | 520 |
| 27 | 1,220 | 1,100 | ..... | ..... | ..... | 6,900 | 1,680 | 1,740 | 810 | 610 | 660 | 520 |
| 28 | 905 | 1,000 | ..... | ..... | ..... | 5,660 | 2,120 | 1,560 | 760 | 610 | 635 | 498 |
| 29 | 855 | 1,160 | ..... | ..... | ..... | 3,360 | 2,180 | 1,410 | 975 | 610 | 610 | 452 |
| 30 | 905 | 1,320 | ..... | ..... | ..... | 2,770 | 1,860 | 1,260 | 1,380 | 610 | 610 | 452 |
| 31 | 3,220 | ..... | ..... | ..... | ..... | 2,380 | ..... | 1,200 | ..... | 610 | 760 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 26, 1918, to Jan. 27, 1919, Feb. 9 and 10, and Mar. 1–9, 1919; discharge ascertained by means of gage heights, observer's notes, and weather records. Stage-discharge relation affected by ice Dec. 9, 1919, to Mar. 2, 1920; observations discontinued and discharge not determined. Stage-discharge relation may possibly have been affected by ice Mar. 3–10, 1920. Discharge interpolated on account of lack of gage readings, Nov. 3, 1918, July 20, Dec. 4, 1919, Apr. 10, May 3 and 29, June 5 and 27, July 12, and Aug. 28, 1920. Discharge estimated on account of lack of gage readings, Feb. 20, 24, and 25, May 20, and Nov. 11, 1919.

*Monthly discharge of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,600 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,680 | 310 | 437 | 0.273 | 0.31 |
| November | 540 | 275 | 385 | .241 | .27 |
| December | 720 | 245 | 467 | .292 | .34 |
| January | 750 | 420 | 535 | .334 | .39 |
| February | 3,360 | 310 | 704 | .440 | .46 |
| March | 10,400 | 650 | 2,660 | 1.66 | 1.91 |
| April | 4,260 | 810 | 1,760 | 1.10 | 1.23 |
| May | 9,800 | 765 | 2,270 | 1.42 | 1.64 |
| June | 5,540 | 855 | 2,390 | 1.49 | 1.66 |
| July | 7,060 | 540 | 1,340 | .838 | .97 |
| August | 4,070 | 480 | 873 | .546 | .63 |
| September | 3,880 | 460 | 918 | .574 | .64 |
| The year | 10,400 | 245 | 1,230 | .769 | 10.45 |
| 1919–20. | | | | | |
| October | 6,600 | 765 | 1,710 | 1.07 | 1.23 |
| November | 9,690 | 1,000 | 2,270 | 1.42 | 1.58 |
| March | 8,400 | 1,200 | 3,440 | 2.15 | 2.48 |
| April | 5,920 | 1,220 | 2,360 | 1.48 | 1.65 |
| May | 8,000 | 1,000 | 1,900 | 1.19 | 1.37 |
| June | 4,140 | 760 | 1,410 | .881 | .98 |
| July | 2,840 | 610 | 897 | .561 | .65 |
| August | 1,440 | 565 | 745 | .466 | .54 |
| September | 710 | 452 | 557 | .348 | .39 |

## ROCK RIVER AT AFTON, WIS.

LOCATION.—On line between secs. 22 and 27, T. 2 N., R. 12 E., at highway bridge in Afton, Rock County, 9 miles above Illinois State line. Bass Creek enters from right three-quarters of a mile below station.

DRAINAGE AREA.—3,190 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—February 5, 1914, to September 30, 1920.

GAGE.—Chain gage fastened to downstream side of bridge; read by George Robb.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and clean silt; practically permanent. Banks medium high and are not overflowed to any extent at flood stages. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.7 feet at 5.45 p. m. April 23 (discharge, 3,340 second-feet); minimum stage, 0.38 foot at 4.50 p. m. August 31 (discharge, about 428 second-feet).

Maximum stage recorded during year ending September 30, 1920, 9.25 feet at 4.30 p. m. April 1 (discharge, 10,000 second-feet); minimum stage, 0.58 foot at 5 p. m. September 19 (discharge, 481 second-feet).

1914–1920: Maximum stage recorded, 10.51 feet at noon March 26, 1918 (discharge, 12,700 second-feet); minimum stage recorded, 0.38 foot August 31, 1919 (discharge, about 428 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plants at Janesville and above causes fluctuations at the gage during low stages.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 638 and 12,700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records, and except for periods during which no gage readings were obtained for which mean discharge was ascertained by comparison with flow of Rock River at Indian Ford dam and at gaging station at Rockford, Ill. Open-water records excellent, except for periods of extreme low water for which they are fair, and except for periods when no gage readings were obtained, for which they may be subject to error; winter records roughly approximate.

*Discharge measurements of Rock River at Afton, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 7 | W. G. Hoyt | 1.22 | 741 | Jan. 16[a] | W. G. Hoyt | 2.89 | 911 |
| 1919. | | | | Feb. 20[b] | S. B. Soulé | 2.58 | 1,170 |
| May 13 | do | 4.29 | 3,020 | May 30 | W. G. Hoyt | 3.88 | 2,510 |
| Dec. 17[c] | do | 2.76 | 943 | | | | |

[a] Complete ice cover at measuring section; incomplete cover at control.
[b] Measurement made part from ice and part from bridge; incomplete ice cover at control.

*Daily discharge, in second-feet, of Rock River at Afton, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 728 | | 728 | 660 | 728 | 730 | 912 | 2,220 | 1,060 | 820 | 866 | 595 |
| 2 | 728 | | 683 | 660 | 728 | 730 | 866 | 1,980 | 1,110 | 820 | 820 | 774 |
| 3 | 728 | | 728 | 660 | 728 | 730 | 866 | 2,220 | 960 | 912 | 728 | 683 |
| 4 | 728 | | 683 | 660 | 728 | 730 | 866 | 2,490 | 1,110 | 728 | 820 | 683 |
| 5 | 728 | | 683 | 660 | 705 | 730 | 866 | 2,760 | 1,060 | 774 | 820 | 638 |
| 6 | 728 | | 683 | 660 | 685 | 730 | 2,940 | 2,940 | 1,110 | 820 | 728 | 595 |
| 7 | | | 683 | 660 | 685 | 730 | 3,040 | 2,940 | 1,010 | 912 | 728 | 487 |
| 8 | 730 | | 683 | 660 | 685 | 730 | 2,940 | 3,040 | 1,060 | 960 | 774 | 638 |
| 9 | | | 683 | 660 | 685 | 728 | 2,490 | 3,040 | 1,110 | 820 | 774 | 683 |
| 10 | 728 | | 728 | 685 | 685 | 774 | 2,670 | 2,940 | 1,290 | 728 | 638 | 820 |
| 11 | 728 | | 728 | 685 | 685 | 774 | 2,310 | 3,140 | 1,360 | 728 | 820 | 912 |
| 12 | 683 | | 683 | 685 | 683 | 820 | 2,850 | 3,240 | 1,580 | 728 | 866 | 820 |
| 13 | 728 | | 728 | 685 | 728 | 820 | 2,490 | 2,850 | 1,500 | 638 | 820 | 728 |
| 14 | 774 | | 728 | 685 | 728 | 774 | 2,670 | 2,670 | 1,500 | 866 | 728 | 555 |
| 15 | 774 | | 683 | 685 | 728 | 820 | 3,140 | 2,490 | 1,430 | 820 | 728 | 683 |
| 16 | 774 | 850 | 728 | 685 | 728 | 912 | 3,040 | 2,140 | 1,580 | 820 | 595 | 638 |
| 17 | 728 | | 728 | 685 | 728 | 912 | 3,040 | 2,060 | 1,500 | 820 | 519 | 683 |
| 18 | 728 | | 728 | 685 | 728 | 912 | 3,040 | 1,980 | 1,500 | 820 | 728 | 683 |
| 19 | 683 | | 728 | 683 | 728 | 912 | 3,140 | 1,900 | 1,500 | 774 | 728 | 728 |
| 20 | | | 728 | 728 | 728 | 960 | 2,940 | 2,140 | 1,430 | 555 | 728 | 820 |
| 21 | | | 728 | 728 | 728 | 960 | 3,040 | 2,060 | 1,430 | 774 | 728 | 1,010 |
| 22 | | | 683 | 728 | 728 | 960 | 3,040 | 1,980 | 1,290 | 728 | 683 | 1,110 |
| 23 | | | 728 | 728 | 728 | 960 | 3,140 | 1,740 | 1,360 | 683 | 683 | 1,010 |
| 24 | | | 685 | 728 | 728 | 960 | 3,040 | 1,710 | 1,290 | 638 | 595 | 1,010 |
| 25 | 750 | | 685 | 728 | 730 | 960 | 2,850 | 1,580 | 1,290 | 638 | 820 | 960 |
| 26 | | | 685 | 683 | 730 | 960 | 2,670 | 1,660 | 1,230 | 595 | 774 | 1,010 |
| 27 | | | 685 | 728 | 730 | 960 | 2,310 | 1,500 | 1,230 | 595 | 683 | 1,010 |
| 28 | | | 685 | 728 | 730 | 912 | 2,410 | 1,230 | 1,110 | 728 | 683 | 774 |
| 29 | | | 685 | 728 | ..... | 912 | 2,140 | 1,170 | 866 | 820 | 638 | 1,230 |
| 30 | | | 685 | 728 | ..... | 912 | 2,140 | 1,010 | 866 | 820 | 595 | 1,360 |
| 31 | | ..... | 685 | 728 | ..... | 912 | ..... | 1,170 | ..... | 866 | 487 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 1,580 | 2,670 | 1,080 | 1,000 | 905 | 1,060 | 9,900 | 4,040 | 2,400 | 3,040 | 1,010 | 960 |
| 2 | 1,900 | 2,490 | 1,070 | 875 | 910 | 1,060 | 9,500 | 3,800 | 2,220 | 2,850 | 866 | 1,010 |
| 3 | 1,900 | 2,760 | 1,060 | 940 | 935 | 1,040 | 8,920 | 3,920 | 2,140 | 2,670 | 820 | 1,060 |
| 4 | 3,560 | 2,670 | 1,010 | 800 | 955 | 970 | 9,900 | 3,560 | 2,220 | 2,310 | 774 | 1,060 |
| 5 | 4,770 | 2,760 | 1,020 | 865 | 970 | 1,010 | 9,500 | 3,340 | 1,900 | 2,220 | 774 | 866 |
| 6 | 3,560 | 2,850 | 1,010 | 945 | 990 | 1,040 | 8,920 | 3,240 | 1,500 | 2,140 | 683 | 1,010 |
| 7 | 3,110 | 2,850 | 1,000 | 840 | 1,010 | 1,060 | 8,370 | 3,040 | 1,580 | 1,660 | 683 | 1,060 |
| 8 | 3,040 | 2,670 | 990 | 850 | 1,030 | 1,080 | 8,200 | 2,850 | 1,170 | 1,430 | 683 | 1,060 |
| 9 | 2,940 | 2,490 | 980 | 855 | 1,050 | 1,110 | 7,860 | 2,580 | 1,010 | 1,500 | 638 | 1,170 |
| 10 | 2,760 | 2,580 | 970 | 835 | 1,060 | 1,170 | 7,530 | 2,490 | 1,110 | 1,500 | 820 | 1,110 |
| 11 | 2,670 | 2,060 | 965 | 790 | 1,110 | 1,230 | 7,060 | 2,760 | 1,010 | 1,290 | 774 | 1,010 |
| 12 | 2,400 | 2,760 | 960 | 905 | 1,110 | 2,060 | 7,080 | 2,670 | 960 | 1,500 | 774 | 866 |
| 13 | 2,310 | 2,580 | 955 | 875 | 1,100 | 3,240 | 6,630 | 2,490 | 912 | 1,500 | 774 | 960 |
| 14 | 2,140 | 2,580 | 950 | 905 | 1,080 | 3,140 | 5,940 | 2,220 | 1,060 | 1,500 | 820 | 1,010 |
| 15 | 2,060 | 2,580 | 945 | 820 | 1,080 | 4,040 | 5,680 | 2,140 | 1,360 | 1,500 | 638 | 1,010 |
| 16 | 2,060 | 2,400 | 940 | 910 | 1,090 | 4,640 | 5,680 | 1,980 | 1,740 | 1,430 | 774 | 960 |
| 17 | 1,820 | 2,490 | 935 | 880 | 1,100 | 5,030 | 5,290 | 2,060 | 3,040 | 1,360 | 820 | 960 |
| 18 | 1,290 | 2,310 | 1,110 | 785 | 1,100 | 5,680 | 4,900 | 1,900 | 3,140 | 1,170 | 820 | 866 |
| 19 | 1,230 | 1,820 | 1,100 | 875 | 1,100 | 6,350 | 4,900 | 1,430 | 3,040 | 1,500 | 866 | 638 |
| 20 | 1,360 | 1,660 | 970 | 1,080 | 1,170 | 6,350 | 5,550 | 1,430 | 3,340 | 1,360 | 912 | 912 |
| 21 | 1,230 | 1,580 | 865 | 890 | 1,100 | 6,490 | 5,030 | 1,500 | 3,680 | 1,290 | 866 | 960 |
| 22 | 1,230 | 1,500 | 965 | 965 | 1,080 | 6,910 | 4,770 | 1,500 | 3,920 | 1,170 | 820 | 912 |
| 23 | 1,230 | 1,290 | 1,000 | 925 | 1,100 | 7,060 | 4,520 | 1,430 | 4,160 | 1,050 | 912 | 866 |
| 24 | 1,290 | 1,740 | 930 | 980 | 1,100 | 7,210 | 4,640 | 2,670 | 4,040 | 960 | 1,010 | 820 |
| 25 | 1,360 | 1,740 | 770 | 755 | 1,110 | 7,690 | 4,400 | 2,060 | 3,920 | 866 | 1,010 | 866 |
| 26 | 1,360 | 1,900 | 950 | 960 | 1,110 | 9,110 | 4,520 | 2,220 | 3,920 | 960 | 960 | 683 |
| 27 | 1,660 | 866 | 965 | 970 | 1,070 | 8,920 | 4,400 | 3,040 | 3,450 | 1,010 | 912 | 866 |
| 28 | 1,900 | 1,100 | 800 | 975 | 1,080 | 9,110 | 4,280 | 3,040 | 3,680 | 866 | 912 | 912 |
| 29 | 1,980 | 1,100 | 965 | 905 | 1,040 | 9,300 | 4,160 | 2,850 | 3,340 | 960 | 866 | 866 |
| 30 | 1,980 | 1,090 | 1,080 | 835 | ..... | 9,700 | 4,160 | 2,670 | 3,240 | 912 | 912 | 866 |
| 31 | 2,400 | ..... | 1,040 | 860 | ..... | 9,900 | ..... | 2,490 | ..... | 820 | 960 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 24, 1918, to Jan. 18, 1919, Feb. 5–11, Feb. 25 to Mar. 8, 1919, and Nov. 28, 1919, to Mar. 13, 1920. Gage not read, Oct. 7–9, 1918, and Oct. 20 to Nov. 30, 1918. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Rock River at Afton, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 3,190 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | | | 738 | 0.231 | 0.27 |
| November | | | 850 | .266 | .30 |
| December | 728 | 683 | 702 | .220 | .25 |
| January | 728 | 660 | 693 | .217 | .25 |
| February | 730 | 685 | 717 | .225 | .23 |
| March | 960 | 728 | 849 | .266 | .31 |
| April | 3,140 | 866 | 2,470 | .774 | .86 |
| May | 3,240 | 1,010 | 2,190 | .687 | .79 |
| June | 1,580 | 866 | 1,260 | .395 | .44 |
| July | 960 | 555 | 766 | .240 | .28 |
| August | 866 | 487 | 720 | .226 | .26 |
| September | 1,360 | 487 | 811 | .254 | .28 |
| The year | 3,240 | 487 | 1,060 | .332 | 4.52 |
| 1919-20. | | | | | |
| October | 4,770 | 1,230 | 2,130 | .668 | .77 |
| November | 2,850 | 866 | 2,130 | .668 | .75 |
| December | 1,110 | 770 | 980 | .307 | .35 |
| January | 1,080 | 755 | 892 | .280 | .32 |
| February | 1,170 | 905 | 1,060 | .332 | .36 |
| March | 9,900 | 970 | 4,640 | 1.45 | 1.67 |
| April | 9,900 | 4,160 | 6,410 | 2.01 | 2.24 |
| May | 4,040 | 1,430 | 2,560 | .802 | .92 |
| June | 4,160 | 912 | 2,470 | .774 | .86 |
| July | 3,040 | 820 | 1,490 | .467 | .54 |
| August | 1,010 | 638 | 834 | .261 | .30 |
| September | 1,170 | 638 | 939 | .294 | .33 |
| The year | 9,900 | 638 | 2,210 | .693 | 9.41 |

*Days of deficiency in discharge of Rock River at Afton, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 500 | | | | | 2 | | 2 | 0.1 |
| 600 | | 1 | 1 | | 12 | | 14 | .6 |
| 700 | | 7 | 15 | 10 | 78 | 7 | 117 | 5.3 |
| 800 | 36 | 41 | 50 | 80 | 189 | 18 | 414 | 18.9 |
| 900 | 62 | 58 | 78 | 104 | 251 | 56 | 609 | 27.8 |
| 1,000 | 87 | 62 | 95 | 131 | 274 | 115 | 764 | 34.9 |
| 1,100 | 113 | 71 | 113 | 164 | 284 | 170 | 915 | 41.7 |
| 1,200 | 132 | 74 | 130 | 182 | 292 | 184 | 994 | 45.3 |
| 1,300 | 146 | 82 | 145 | 201 | 300 | 194 | 1,068 | 48.7 |
| 1,400 | 158 | 85 | 154 | 210 | 303 | 200 | 1,110 | 50.6 |
| 1,500 | 175 | 95 | 160 | 218 | 312 | 216 | 1,176 | 53.6 |
| 1,625 | 182 | 105 | 168 | 226 | 315 | 219 | 1,215 | 55.4 |
| 1,750 | 196 | 110 | 171 | 227 | 318 | 225 | 1,247 | 56.9 |
| 1,900 | 204 | 118 | 172 | 230 | 319 | 233 | 1,276 | 58.2 |
| 2,000 | 223 | 147 | 184 | 235 | 322 | 236 | 1,347 | 61.5 |
| 2,300 | 236 | 171 | 213 | 243 | 330 | 251 | 1,444 | 65.9 |
| 2,600 | 257 | 203 | 247 | 258 | 337 | 269 | 1,571 | 71.7 |
| 3,000 | 276 | 228 | 257 | 283 | 351 | 288 | 1,683 | 76.8 |
| 3,500 | 296 | 253 | 269 | 305 | 365 | 305 | 1,793 | 81.8 |
| 4,100 | 309 | 278 | 291 | 313 | | 318 | 1,874 | 85.5 |
| 4,800 | 315 | 298 | 316 | 321 | | 330 | 1,945 | 88.7 |
| 6,000 | 335 | 337 | 332 | 330 | | 340 | 2,039 | 93.0 |
| 8,000 | 363 | 356 | 353 | 337 | | 352 | 2,126 | 97.0 |
| 10,500 | 365 | 366 | 365 | 340 | | 366 | 2,167 | 98.9 |
| 13,000 | | | | 365 | | | 2,192 | 100.0 |
| Mean discharge (sec-ft.) | 2,350 | 2,950 | 2,560 | 2,440 | 1,060 | 2,210 | | |
| Maximum (sec.-ft.) | 8,910 | 9,200 | 8,470 | 12,700 | 3,240 | 9,900 | | |
| Minimum (sec.-ft.) | 705 | 541 | 555 | 638 | 487 | 638 | | |

### ROCK RIVER AT ROCKFORD, ILL.

LOCATION.—In sec. 34, T. 44 N., R. 1 E., at highway bridge at Nelson Avenue, Rockford, Winnebago County, 1 mile below mouth of Kent Creek.

DRAINAGE AREA.—6,520 square miles.

RECORDS AVAILABLE.—July 30, 1914, to April 30, 1919, when station was discontinued.

GAGE.—Chain gage attached to upstream side of bridge; read by Winston Burrows.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and rock; may shift during high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 1, 1918, to April 30, 1919, 11.3 feet at 7 a. m. March 19 (discharge, 24,600 second-feet); minimum stage, 0.82 foot at 5.30 p. m. October 20 (discharge, 845 second-feet).

1914–1919: Maximum stage recorded, 13.0 feet March 30 and 31, 1916 (discharge, 32,000 second-feet); minimum discharge recorded, 483 second-feet, August 9, 1914.

REGULATION.—Operation of power plant at dam 2 miles upstream in Rockford causes fluctuation at gage. During low stages water is stored at night for use in manufacturing plants during day.

ACCURACY.—Stage-discharge relation permanent during period except as affected by ice during January. Rating curve fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to table of daily discharge. Records good for medium and high stages during open-water periods; probably somewhat too large for low stages on account of gage readings having been taken during day, when flow owing to regulation at dam, was somewhat greater than during night; winter records poor.

The following discharge measurement was made by H. C. Beckman:

April 9, 1919: Gage height, 4.24 feet; discharge, 4,780 second-feet.

*Daily discharge, in second-feet, of Rock River at Rockford, Ill., for the period Oct. 1, 1918, to Apr. 30, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|
| 1 | 1,370 | 1,640 | 1,540 | 2,410 | 2,540 | 2,540 | 3,530 |
| 2 | 1,370 | 1,740 | 1,840 | 2,410 | 2,060 | 2,260 | 3,860 |
| 3 | 1,450 | 1,370 | 1,950 | 2,410 | 2,410 | 2,540 | 4,610 |
| 4 | 1,540 | 1,740 | 2,060 | 2,410 | 2,290 | 2,820 | 4,820 |
| 5 | 1,540 | 2,170 | 2,060 | 2,410 | 2,410 | 3,100 | 4,720 |
| 6 | 1,290 | 1,950 | 1,840 | 2,410 | 2,170 | 3,240 | 4,610 |
| 7 | 1,290 | 1,840 | 1,540 | ..... | 2,060 | 3,240 | 5,450 |
| 8 | 1,290 | 1,740 | 1,160 | ..... | 1,950 | 3,240 | 5,450 |
| 9 | 1,290 | 1,640 | 1,370 | ..... | 1,640 | 3,100 | 5,240 |
| 10 | 1,220 | 1,290 | 2,060 | ..... | 2,170 | 3,240 | 4,820 |
| 11 | 1,220 | 1,450 | 2,540 | ..... | 2,540 | 3,380 | 4,820 |
| 12 | 1,100 | 1,540 | 2,820 | ..... | 2,680 | 3,530 | 4,610 |
| 13 | 1,040 | 1,840 | 2,960 | ..... | 2,960 | 3,530 | 4,610 |
| 14 | 1,160 | 2,170 | 3,100 | ..... | 3,240 | 4,610 | 4,610 |
| 15 | 1,370 | 2,170 | 2,540 | ..... | 3,690 | 9,430 | 4,820 |
| 16 | 1,640 | 2,170 | 2,820 | ..... | 3,100 | 14,500 | 5,100 |
| 17 | 1,740 | 1,640 | 2,960 | ..... | 3,530 | 18,500 | 5,380 |
| 18 | 1,640 | 1,740 | 2,960 | ..... | 4,030 | 22,200 | 5,660 |
| 19 | 1,640 | 1,950 | 3,100 | ..... | 3,530 | 24,200 | 5,660 |
| 20 | 845 | 2,060 | 2,960 | ..... | 3,100 | 21,500 | 4,820 |
| 21 | 1,100 | 1,950 | 2,680 | ..... | 2,960 | 19,400 | 5,030 |
| 22 | 1,450 | 1,840 | 1,840 | ..... | 3,240 | 17,600 | 5,240 |
| 23 | 1,640 | 1,740 | 2,170 | ..... | 2,410 | 15,900 | 5,240 |
| 24 | 1,740 | 1,220 | 2,820 | ..... | 2,540 | 14,800 | 5,450 |
| 25 | 1,640 | 1,290 | 3,240 | ..... | 3,100 | 13,100 | 5,450 |
| 26 | 1,540 | 1,450 | 3,380 | ..... | 2,820 | 10,200 | 5,450 |
| 27 | 1,040 | 1,740 | 3,380 | ..... | 2,680 | 9,680 | 4,400 |
| 28 | 1,220 | 1,840 | 3,240 | ..... | 2,680 | 9,180 | 4,030 |
| 29 | 1,450 | 1,950 | 1,840 | ..... | ..... | 8,430 | 3,690 |
| 30 | 1,640 | 2,060 | 2,060 | 2,540 | ..... | 7,230 | 3,690 |
| 31 | 1,640 | ..... | 2,290 | 2,410 | ..... | 7,000 | ..... |

NOTE.—No record obtained Jan. 7–29. Stage-discharge relation affected by ice Jan. 1–6; discharge ascertained by means of gage heights, observer's notes, and weather records. Discharge interpolated Apr. 5, 16, and 17 on account of lack of gage readings.

*Monthly discharge of Rock River at Rockford, Ill., for the period Oct. 1, 1918, to Apr. 30, 1919.*

[Drainage area, 6,520 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| October | 1,740 | 845 | 1,390 | 0.213 | 0.25 |
| November | 2,170 | 1,220 | 1,760 | .270 | .30 |
| December | 3,380 | 1,160 | 2,420 | .371 | .43 |
| February | 4,030 | 1,640 | 2,730 | .419 | .44 |
| March | 24,200 | 2,290 | 9,270 | 1.42 | 1.64 |
| April | 5,660 | 3,530 | 4,830 | .741 | .83 |

### ROCK RIVER AT LYNDON, ILL.

LOCATION.—In sec. 21, T. 20 N., R. 5 E., at highway bridge known as Lyndon Bridge, in eastern part of Lyndon, Whiteside County, 10 miles above Rock Creek and 20 miles below dam at Sterling.

DRAINAGE AREA.—9,010 square miles.

RECORDS AVAILABLE.—November 24, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by George Cady.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 16.5 feet at 7 a. m. March 20 (discharge, 37,000 second-feet); minimum stage recorded, 4.05 feet at 7 a. m. October 7 and 6 p. m. October 10 (discharge, 732 second-feet).

Maximum stage recorded during year ending September 30, 1920, 16.29 feet at 7 a. m. March 27 (discharge, 36,200 second-feet); minimum stage recorded, 4.72 feet at 8 a. m. August 1 (discharge, 1,360 second-feet).

1915–1920: Maximum stage recorded, 19.6 feet February 16, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 17.0 feet March 28, 1916 (discharge, 39,500 second-feet); minimum stage, 3.72 feet September 27, 1918 (discharge, 536 second-feet).

DIVERSIONS.—Water is diverted at Sterling dam to feed Illinois and Mississippi canal; probably averages about 100 second-feet.

REGULATION.—Flow past gage is regulated by power plants in city of Sterling and above. Diurnal fluctuation is quite large at low stages.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 700 and 25,000 second-feet; fairly well defined beyond those limits. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good for medium stages, and fair for high and low stages; winter records poor.

*Discharge measurements of Rock River at Lyndon, Ill., during the years ending Sept. 30, 1919 and 1920.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| 1918. | *Feet.* | *Sec.-ft.* |
| Oct. 9 | 4.67 | 1,280 |
| 1919. | | |
| Apr. 7 | 7.51 | 6,720 |
| July 24 | 4.91 | 1,690 |
| Oct. 10 | 8.67 | 10,100 |

*Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 1,030 | 2,400 | 1,620 | 2,740 | 4,610 | 5,050 | 9,000 | 5,270 | 2,910 | 2,910 | 1,760 | 1,690 |
| 2 | 1,490 | 2,400 | 1,760 | | 2,570 | 5,500 | 9,000 | 4,610 | 3,980 | 2,910 | 2,230 | 1,490 |
| 3 | 1,030 | 2,570 | 1,760 | 3,200 | 2,400 | 7,250 | 8,000 | 8,750 | 3,780 | 2,570 | 1,690 | 1,360 |
| 4 | 1,360 | 2,230 | 1,760 | | 2,070 | 10,000 | 8,750 | 20,800 | 3,980 | 2,570 | 2,740 | 1,490 |
| 5 | 1,240 | 1,690 | 1,760 | | 1,420 | 7,500 | 7,500 | 27,000 | 3,780 | 2,910 | 3,600 | 1,490 |
| 6 | 1,690 | 1,620 | 1,910 | | 1,910 | 4,610 | 8,250 | 27,000 | 4,190 | 2,570 | 5,500 | 1,560 |
| 7 | 1,080 | 1,910 | 1,690 | | 2,070 | 4,610 | 7,000 | 25,200 | 4,190 | 2,740 | 5,500 | 1,490 |
| 8 | 1,620 | 1,760 | 1,560 | 3,400 | 2,070 | 4,830 | 8,000 | 24,100 | 4,190 | 1,760 | 3,250 | 1,420 |
| 9 | 1,240 | 1,690 | 2,230 | | 2,340 | 6,000 | 6,750 | 19,400 | 4,610 | 2,400 | 3,080 | 1,420 |
| 10 | 885 | 2,230 | 2,230 | | 3,210 | 5,270 | 6,250 | 15,700 | 3,980 | 2,570 | 2,400 | 1,420 |
| 11 | 1,130 | 1,760 | 1,910 | | 4,830 | 6,750 | 7,500 | 12,100 | 2,070 | 2,740 | 2,910 | 1,560 |
| 12 | 1,180 | 1,910 | 1,910 | | 3,250 | 7,750 | 6,750 | 10,200 | 3,780 | 2,400 | 2,570 | 1,560 |
| 13 | 885 | 1,360 | 2,070 | | 2,740 | 9,750 | 8,000 | 8,250 | 4,610 | 2,570 | 2,230 | 1,420 |
| 14 | 930 | 2,070 | 1,420 | | 3,420 | 11,000 | 7,250 | 7,750 | 4,190 | 2,740 | 2,400 | 1,490 |
| 15 | 1,180 | 1,760 | 2,230 | 3,600 | 4,830 | 10,500 | 5,750 | 8,000 | 4,190 | 2,400 | 2,070 | 2,230 |
| 16 | 1,300 | 1,760 | 3,250 | | 3,600 | 23,400 | 7,000 | 7,250 | 4,190 | 2,910 | 1,910 | 2,740 |
| 17 | 1,180 | 1,690 | 2,740 | | 4,190 | 33,000 | 7,250 | 8,250 | 3,980 | 2,400 | 1,690 | 2,400 |
| 18 | 1,620 | 2,400 | 2,570 | | 4,400 | 35,800 | 7,750 | 6,750 | 4,400 | 2,570 | 2,910 | 2,070 |
| 19 | 1,030 | 1,760 | 3,080 | | 4,470 | 36,600 | 7,750 | 6,500 | 4,400 | 2,400 | 2,070 | 1,910 |
| 20 | 802 | 1,760 | 3,080 | | 4,540 | 37,000 | 7,250 | 6,250 | 4,190 | 2,740 | 1,910 | 1,910 |
| 21 | 1,690 | 1,690 | 2,910 | | 4,610 | 34,200 | 7,750 | 5,270 | 3,980 | 2,740 | 2,230 | 2,740 |
| 22 | 1,560 | 2,070 | 2,070 | | 3,780 | 32,600 | 7,250 | 5,270 | 3,980 | 1,360 | 2,070 | 4,190 |
| 23 | 1,360 | 1,910 | 3,080 | | 3,080 | 29,400 | 7,750 | 6,000 | 3,780 | 1,760 | 2,570 | 4,190 |
| 24 | 1,690 | 1,620 | 1,910 | 3,800 | 2,740 | 24,500 | 7,500 | 6,000 | 3,980 | 1,910 | 1,490 | 4,830 |
| 25 | 1,690 | 1,910 | 3,080 | | 3,080 | 21,600 | 7,500 | 6,500 | 3,780 | 1,910 | 2,230 | 5,050 |
| 26 | 1,690 | 2,070 | 3,250 | | 3,600 | 18,400 | 7,750 | 5,050 | 3,600 | 1,420 | 2,740 | 5,050 |
| 27 | 1,420 | 1,760 | 2,910 | | 3,420 | 13,200 | 8,500 | 4,610 | 3,600 | 1,760 | 2,230 | 5,050 |
| 28 | 2,230 | 1,760 | 3,080 | 3,980 | 3,080 | 11,300 | 6,750 | 4,190 | 3,420 | 1,910 | 1,910 | 4,830 |
| 29 | 1,760 | 2,070 | 2,570 | 3,980 | ..... | 10,800 | 5,750 | 3,980 | 2,910 | 1,760 | 1,690 | 4,400 |
| 30 | 2,070 | 2,230 | 3,250 | 3,600 | ..... | 8,500 | 4,610 | 3,420 | 3,080 | 1,300 | 1,910 | 3,980 |
| 31 | 2,230 | ..... | 3,080 | 3,420 | ..... | 8,750 | ..... | 3,780 | ..... | 1,560 | 1,620 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 5,750 | 20,500 | 3,600 | | | | 27,000 | 11,500 | 6,750 | 5,500 | 2,400 | ..... |
| 2 | 9,750 | 13,500 | 3,250 | | | | 26,700 | 11,800 | 7,000 | 5,270 | 2,910 | ..... |
| 3 | 7,500 | 12,900 | 3,600 | | | | 24,800 | 11,800 | 6,500 | 5,500 | 2,740 | ..... |
| 4 | 7,750 | 10,500 | 4,400 | | | | 23,700 | 11,000 | 6,000 | 5,330 | 2,070 | ..... |
| 5 | 9,500 | 11,300 | 8,500 | | | | 21,200 | 10,000 | 5,550 | 5,160 | 2,230 | ..... |
| 6 | 12,400 | 10,200 | | | | 12,000 | 20,800 | 9,250 | 5,100 | 5,100 | 2,230 | ..... |
| 7 | 10,500 | 9,250 | | | | | 20,500 | 8,500 | 4,650 | 4,830 | ..... | ..... |
| 8 | 11,300 | 8,250 | | | | | 18,800 | 7,750 | 4,190 | 4,190 | ..... | ..... |
| 9 | 10,000 | 7,250 | | | | | 18,000 | 7,500 | 4,190 | 4,190 | ..... | ..... |
| 10 | 10,200 | 8,250 | | | | | 17,000 | 7,250 | 4,190 | 3,780 | ..... | ..... |
| | | | 15,000 | | 3,600 | | | | | | | |
| 11 | 9,750 | 9,000 | | | | | 16,700 | 6,750 | 3,980 | 3,420 | ..... | ..... |
| 12 | 8,750 | 9,250 | | | | 25,000 | 14,400 | 7,250 | 3,600 | 3,600 | ..... | ..... |
| 13 | 7,000 | 9,750 | | | | 35,000 | 11,800 | 7,750 | 3,420 | 3,980 | ..... | ..... |
| 14 | 6,250 | 9,500 | | | | 32,200 | 11,500 | 7,500 | 3,780 | 3,780 | ..... | ..... |
| 15 | 5,750 | 9,500 | | | | 22,300 | 11,300 | 7,250 | 3,780 | 3,780 | ..... | ..... |
| 16 | 6,500 | 9,250 | | 3,200 | | 20,500 | 11,000 | 6,500 | 4,400 | 4,190 | ..... | ..... |
| 17 | 5,050 | 8,250 | | | | 21,900 | 11,000 | 6,000 | 5,050 | 3,250 | ..... | ..... |
| 18 | 4,610 | 6,750 | | | | 21,200 | 10,200 | 5,750 | 6,000 | 3,600 | ..... | ..... |
| 19 | 4,400 | 6,500 | | | | 20,200 | 10,500 | 6,250 | 7,250 | 3,420 | ..... | ..... |
| 20 | 4,400 | 6,250 | | | | 21,200 | 11,500 | 6,000 | 7,000 | 3,630 | ..... | ..... |
| | | | 9,000 | | | | | | | | | |
| 21 | 3,980 | 5,500 | | | | 23,000 | 13,500 | 5,500 | 7,900 | 3,080 | ..... | ..... |
| 22 | 3,780 | 5,500 | | | | 23,400 | 14,100 | 5,270 | 8,750 | 3,250 | ..... | ..... |
| 23 | 3,980 | 4,830 | | | | 21,600 | 14,100 | 5,500 | 7,750 | 3,250 | ..... | ..... |
| 24 | 3,780 | 5,270 | | | | 20,500 | 13,500 | 5,500 | 7,500 | 3,250 | ..... | ..... |
| 25 | 3,600 | 5,050 | | | 4,500 | 23,400 | 13,200 | 5,500 | 7,250 | 3,080 | ..... | ..... |
| 26 | 3,600 | 5,050 | | | | 33,800 | 12,900 | 5,750 | 6,750 | 3,080 | ..... | ..... |
| 27 | 3,780 | 4,830 | | | | 36,200 | 12,100 | 5,750 | 6,500 | 3,080 | ..... | ..... |
| 28 | 3,600 | 4,830 | | | | 35,400 | 11,500 | 6,000 | 6,500 | 2,740 | ..... | ..... |
| 29 | 4,190 | 3,980 | 5,500 | | | 33,000 | 11,500 | 6,000 | 6,000 | 2,740 | ..... | ..... |
| 30 | 4,610 | 4,190 | | | ..... | 29,800 | 11,300 | 6,000 | 6,250 | 2,740 | ..... | ..... |
| 31 | 6,000 | ..... | | | ..... | 29,000 | ..... | 5,750 | ..... | 2,230 | ..... | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 2-27, Feb. 9-11, 1919, and Dec. 5, 1919, to Mar. 11, 1920; discharge ascertained by means of gage heights, observer's notes, and weather records. Discharge interpolated on account of lack of gage readings, Feb. 19 and 20, 1919, June 4-7 and 21, and July 4-6, 1920. Discharge estimated on account of lack of gage readings, Mar. 12, 1920. Gage not read Aug. 6 to Sept. 30, 1920; bridge being repaired. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Rock River at Lyndon, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 9,010 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,230 | 802 | 1,400 | 0.155 | 0.18 |
| November | 2,570 | 1,360 | 1,930 | .214 | .24 |
| December | 3,250 | 1,420 | 2,380 | .264 | .30 |
| January | | | 3,550 | .394 | .45 |
| February | 4,830 | 1,420 | 3,300 | .366 | .38 |
| March | 37,000 | 4,610 | 15,700 | 1.74 | 2.01 |
| April | 9,000 | 4,610 | 7,400 | .821 | .92 |
| May | 27,000 | 3,420 | 10,100 | 1.12 | 1.29 |
| June | 4,610 | 2,070 | 3,860 | .428 | .48 |
| July | 2,910 | 1,300 | 2,300 | .255 | .29 |
| August | 5,500 | 1,490 | 2,490 | .276 | .32 |
| September | 5,050 | 1,360 | 2,610 | .290 | .32 |
| The year | 37,000 | 802 | 4,770 | .529 | 7.18 |
| 1919–20. | | | | | |
| October | 12,400 | 3,600 | 6,520 | .724 | .83 |
| November | 20,500 | 3,980 | 8,160 | .906 | 1.01 |
| December | | | 9,560 | 1.06 | 1.22 |
| January | | | 3,200 | .355 | .41 |
| February | | | 3,880 | .431 | .46 |
| March | 36,200 | | 21,300 | 2.36 | 2.72 |
| April | 27,000 | 10,600 | 15,500 | 1.72 | 1.92 |
| May | 11,500 | 5,270 | 7,290 | .809 | .93 |
| June | 8,750 | 3,420 | 5,780 | .642 | .72 |
| July | 5,500 | 2,230 | 3,810 | .423 | .49 |
| August 1–6 | 2,910 | 2,070 | 2,430 | .269 | .06 |

### PECATONICA RIVER AT DILL, WIS.

LOCATION.—In sec. 6, T. 1 N., R. 6 E., at Illinois Central Railroad bridge at Dill (Ramona post office), Green County, 1 mile below junction of East and West branches of Pecatonica River and 9 miles above Illinois State line.

DRAINAGE AREA.—959 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 9, 1914, to September 30, 1919, when station was discontinued.

GAGE.—Chain gage fastened to downstream side of bridge; read by S. A. Frank. Prior to August 2, 1916, vertical staff gage on left abutment.

DISCHARGE MEASUREMENTS.—At low and medium stages made from downstream side of highway bridge about 400 feet above gage; during extremely high water considerable water overflows to left of highway bridge and measurements are made from railroad bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud; shifting. Banks medium high, and are overflowed at flood stages. Except during extreme flood stages all the water passes under the railroad bridge to which the gage is fastened. There is little fall in the river below the gage and no well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.7 feet about noon March 17 (discharge, about 6,770 second-feet); minimum stage, 0.56 foot at 5 p. m. November 25 (discharge, about 166 second-feet).

1914–1919: Maximum stage recorded, 19.1 feet March 27, 1916, determined from flood marks by leveling (discharge, about 13,100 second-feet); minimum stage, 0.56 foot November 25, 1918 (discharge, about 166 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operation of dams at Argyle, on East Branch of Pecatonica River, and at Darlington, on West Branch of Pecatonica River, cause little if any diurnal fluctuation at gage.

ACCURACY.—Stage-discharge relation not permanent; affected by ice. Two rating curves used, both poorly defined; one, applicable October 1 to March 11, was used directly, the other, applicable March 12 to September 30, was used directly except during periods March 12–20 and August 1 to September 30, during which indirect method for shifting channel was used. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which indirect method for shifting channel was used and except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of observer's notes and weather records. Open-water records fair; winter records subject to error.

*Discharge measurements of Pecatonica River at Dill, Wis., during the year ending Sept. 30, 1919.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Oct. 8 | H. C. Beckman | 0.79 | 204 | Mar. 22 | S. B. Soulé | 2.36 | 684 |
| Dec. 10 | S. B. Soulé | 2.71 | 703 | May 13 | W. G. Hoyt | 2.02 | 586 |
| Mar. 18 | do | 12.46 | 5,800 | Aug. 17 | do | 1.21 | 321 |

*Daily discharge, in second-feet, of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 210 | 234 | 270 | 215 | 290 | 235 | 426 | 498 | 498 | 378 | 2,100 | 274 |
| 2 | 204 | 238 | 225 | 205 | 245 | 235 | 414 | 524 | 920 | 367 | 1,640 | 275 |
| 2 | 195 | 240 | 225 | 195 | 225 | 225 | 414 | 630 | 1,080 | 356 | 1,280 | 278 |
| 4 | 204 | 238 | 225 | 190 | 215 | 290 | 414 | 772 | 846 | 356 | 596 | 281 |
| 5 | 206 | 236 | 225 | 190 | 205 | 290 | 414 | 735 | 735 | 450 | 378 | 282 |
| 6 | 206 | 230 | 235 | 190 | 195 | 245 | 426 | 772 | 630 | 664 | 735 | 281 |
| 7 | 208 | 234 | 246 | 190 | 190 | 205 | 537 | 1,080 | 565 | 450 | 511 | 275 |
| 8 | 204 | 257 | 257 | 190 | 190 | 245 | 809 | 1,240 | 537 | 390 | 390 | 270 |
| 9 | 204 | 246 | 312 | 190 | 190 | 290 | 809 | 809 | 511 | 390 | 356 | 260 |
| 10 | 208 | 244 | 640 | 195 | 190 | 335 | 883 | 772 | 511 | 565 | 345 | 450 |
| 11 | 206 | 228 | 610 | 195 | 190 | 1,600 | 920 | 664 | 551 | 524 | 321 | 1,560 |
| 12 | 212 | 220 | 522 | 205 | 205 | 3,480 | 630 | 596 | 565 | 378 | 292 | 1,080 |
| 13 | 208 | 212 | 348 | 215 | 290 | 4,230 | 565 | 565 | 698 | 378 | 345 | 402 |
| 14 | 206 | 218 | 336 | 225 | 1,200 | 4,740 | 551 | 551 | 809 | 367 | 367 | 356 |
| 15 | 206 | 222 | 312 | 225 | 1,600 | 4,690 | 630 | 537 | 772 | 438 | 345 | 316 |
| 16 | 208 | 230 | 290 | 225 | 1,200 | 5,970 | 698 | 537 | 735 | 367 | 335 | 302 |
| 17 | 204 | 236 | 268 | 235 | 805 | 6,690 | 772 | 524 | 1,000 | 356 | 316 | 293 |
| 18 | 202 | 246 | 257 | 235 | 440 | 5,890 | 735 | 524 | 809 | 335 | 314 | 297 |
| 19 | 195 | 268 | 257 | 245 | 425 | 5,020 | 698 | 498 | 596 | 335 | 323 | 735 |
| 20 | 201 | 257 | 246 | 245 | 386 | 3,730 | 664 | 474 | 565 | 335 | 304 | 1,240 |
| 21 | 199 | 234 | 257 | 255 | 373 | 883 | 630 | 450 | 537 | 335 | 414 | 2,980 |
| 22 | 204 | 216 | 245 | 268 | 399 | 735 | 630 | 462 | 498 | 325 | 462 | 3,430 |
| 23 | 206 | 202 | 245 | 324 | 438 | 664 | 630 | 498 | 486 | 345 | 325 | 3,280 |
| 24 | 214 | 183 | 235 | 360 | 360 | 596 | 630 | 524 | 511 | 345 | 312 | 1,800 |
| 25 | 228 | 167 | 225 | 386 | 290 | 551 | 565 | 486 | 537 | 323 | 288 | 846 |
| 26 | 228 | 180 | 225 | 438 | 270 | 537 | 537 | 462 | 462 | 335 | 295 | 537 |
| 27 | 301 | 202 | 225 | 466 | 255 | 511 | 486 | 426 | 414 | 316 | 286 | 450 |
| 28 | 466 | 205 | 225 | 412 | 245 | 486 | 486 | 414 | 390 | 356 | 288 | 438 |
| 29 | 399 | 290 | 225 | 386 | ..... | 474 | 474 | 414 | 390 | 367 | 287 | 462 |
| 30 | 312 | 290 | 225 | 386 | ..... | 462 | 474 | 402 | 390 | 356 | 288 | 537 |
| 31 | 257 | ..... | 225 | 336 | ..... | 450 | ..... | 402 | ..... | 1,240 | 290 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 28 to Dec. 6, Dec. 22 to Jan. 21, Feb. 1–18, and Feb. 24 to Mar. 11.

*Monthly discharge of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1919.*

[Drainage area, 959 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| October | 466 | 195 | 229 | 0.239 | 0.28 |
| November | 290 | 167 | 230 | .240 | .27 |
| December | 640 | 225 | 286 | .298 | .34 |
| January | 466 | 190 | 265 | .276 | .32 |
| February | 1,600 | 190 | 411 | .429 | .45 |
| March | 6,690 | 205 | 1,770 | 1.85 | 2.13 |
| April | 920 | 414 | 598 | .624 | .70 |
| May | 1,240 | 402 | 588 | .613 | .71 |
| June | 1,080 | 390 | 618 | .644 | .72 |
| July | 1,240 | 316 | 414 | .432 | .50 |
| August | 2,100 | 286 | 488 | .509 | .59 |
| September | 3,430 | 260 | 809 | .844 | .94 |
| The year | 6,690 | 167 | 560 | .584 | 7.95 |

*Days of deficiency in discharge of Pecatonica River at Dill, Wis., for the years ending Sept. 30, 1915–1919.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | Oct. 1, 1914, to Sept. 30, 1919. | |
|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | Total days. | Per cent of time. |
| 175 | | | | | 1 | 1 | 0.1 |
| 200 | | | | 9 | 21 | 30 | 1.6 |
| 225 | | | | 50 | 74 | 124 | 6.8 |
| 250 | 11 | | | 126 | 106 | 243 | 13.3 |
| 275 | 21 | | 36 | 161 | 125 | 343 | 18.8 |
| 300 | 31 | | 80 | 209 | 149 | 469 | 25.7 |
| 325 | 52 | 3 | 115 | 248 | 165 | 583 | 31.9 |
| 350 | 72 | 9 | 128 | 278 | 181 | 668 | 36.6 |
| 375 | 75 | 16 | 149 | 297 | 195 | 732 | 40.1 |
| 400 | 84 | 35 | 171 | 305 | 211 | 806 | 44.1 |
| 425 | 117 | 50 | 199 | 308 | 225 | 899 | 49.2 |
| 450 | 147 | 59 | 228 | 311 | 239 | 984 | 53.9 |
| 475 | 167 | 80 | 263 | 311 | 250 | 1,071 | 58.7 |
| 500 | 193 | 93 | 282 | 313 | 260 | 1,141 | 62.5 |
| 550 | 226 | 141 | 297 | 315 | 280 | 1,259 | 69.0 |
| 600 | 251 | 200 | 313 | 319 | 296 | 1,379 | 75.5 |
| 650 | 269 | 230 | 322 | 320 | 307 | 1,448 | 79.3 |
| 800 | 295 | 277 | 329 | 323 | 328 | 1,552 | 85.0 |
| 1,100 | 329 | 316 | 336 | 328 | 341 | 1,650 | 90.4 |
| 1,600 | 339 | 334 | 345 | 331 | 350 | 1,699 | 93.0 |
| 2,500 | 348 | 350 | 353 | 344 | 353 | 1,748 | 95.7 |
| 4,000 | 355 | 356 | 362 | 354 | 358 | 1,785 | 97.8 |
| 7,000 | 365 | 363 | 365 | 365 | 365 | 1,823 | 99.8 |
| 10,000 | | 364 | | | | 1,824 | 99.9 |
| 14,000 | | 366 | | | | 1,826 | 100.0 |
| Mean discharge (sec.-ft.) | 741 | 883 | 558 | 586 | 560 | | |
| Maximum (sec.-ft.) | 6,590 | 13,100 | 4,430 | 5,820 | 6,690 | | |
| Minimum (sec.-ft.) | [a] 245 | 314 | 260 | 182 | 167 | | |

[a] Approximate.

### PECATONICA RIVER AT FREEPORT, ILL.

LOCATION.—In sec. 32, T. 27 N., R. 8 E., at highway bridge at Hancock Avenue, half a mile east of Illinois Central Railroad station at Freeport, Stephenson County, and 2 miles above mouth of Yellow Creek.

DRAINAGE AREA.—1,330 square miles.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1920.

GAGE.—Chain gage attached to upstream side of bridge; read by W. C. Krueger.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and silt; probably shifting. Left bank of medium height and is overflowed during high water; at stages above about 16.0 feet part of the flow passes over left bank and through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 17.6 feet at 4.30 p. m. March 16 (discharge, 10,000 second-feet); minimum stage, 2.9 feet at 5.30 p.m. November 24 (discharge, 222 second-feet).

Maximum stage recorded during year ending September 30, 1920, 15.5 feet at 5 p. m. March 16 (discharge, 5,380 second-feet); minimum stage, 4.28 feet at 7 a. m. September 20 (discharge, 425 second-feet).

1914–1919: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum discharge, 200 second-feet at 5 p. m. December 14, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operations at dam and power plant three-quarters of a mile upstream regulate flow past gage; only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed March 22, 1919, and again on May 2, 1919; seriously affected by ice. Three rating curves used during 1919 and 1920, all of which are revisions of old rating curve at low or medium stages; first curve, applicable October 1–18, 1918, and March 23 to May 2, 1919, is fairly well defined throughout; second curve, applicable, October 19, 1918, to March 22, 1919, is well defined between 552 and 6,260 second-feet; third curve, applicable May 3, 1919, to September 30, 1920, is well defined between 350 and 7,000 second-feet and fairly well defined outside these limits. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods December 22, 1918, to January 20, 1919, February 7–10, 1919, March 1–10, 1919, and December 1, 1919, to March 10, 1920, during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by means of gage heights, observer's notes, and weather records. Open water records good for medium and high stages, fair for low stages; winter records poor.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Pecatonica River at Freeport, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | | Gage height. | Discharge. | Date. | | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Oct. 8 | ..... | 3.48 | 270 | Apr. 8 | ..... | 6.24 | 778 |
| 29 | ..... | 5.42 | 645 | July 23 | ..... | 4.09 | 403 |

*Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 256 | 442 | 361 | | 514 | | 600 | 640 | 670 | 510 | 1,680 | 345 |
| 2 | 243 | 346 | 318 | | 376 | | 580 | 700 | 850 | 490 | 1,620 | 345 |
| 3 | 270 | 332 | 290 | | 361 | | 580 | 1,500 | 1,220 | 490 | 1,530 | 345 |
| 4 | 345 | 332 | 276 | | 346 | | 560 | 3,240 | 1,190 | 470 | 1,290 | 345 |
| 5 | 330 | 318 | 276 | | 332 | | 560 | 2,720 | 1,020 | 530 | 790 | 345 |
| | | | | 300 | | 535 | | | | | | |
| 6 | 285 | 304 | 304 | | 318 | | 580 | 1,560 | 890 | 570 | 670 | 345 |
| 7 | 300 | 276 | 318 | | | | 720 | 1,360 | 810 | 570 | 890 | 345 |
| 8 | 285 | 290 | 304 | | | | 1,010 | 1,860 | 810 | 550 | 690 | 345 |
| 9 | 256 | 290 | 304 | | 315 | | 985 | 1,650 | 790 | 510 | 570 | 345 |
| 10 | 270 | 290 | 442 | | | | 1,010 | 1,190 | 810 | 610 | 470 | 330 |
| 11 | 285 | 290 | 714 | | 361 | 3,750 | 960 | 1,040 | 810 | 750 | 450 | 610 |
| 12 | 300 | 346 | 757 | | 361 | 3,450 | 935 | 940 | 870 | 630 | 450 | 1,240 |
| 13 | 270 | 318 | 735 | | 376 | 4,000 | 810 | 870 | 850 | 510 | 450 | 940 |
| 14 | 300 | 304 | 632 | | 1,040 | 4,180 | 720 | 850 | 790 | 470 | 470 | 570 |
| 15 | 285 | 304 | 533 | | 1,830 | 4,660 | 860 | 810 | 940 | 965 | 450 | 450 |
| | | | | 315 | | | | | | | | |
| 16 | 270 | 290 | 514 | | 1,740 | 8,790 | 985 | 770 | 915 | 650 | 435 | 450 |
| 17 | 270 | 318 | 460 | | 1,470 | 8,790 | 1,080 | 770 | 940 | 530 | 450 | 390 |
| 18 | 270 | 318 | 408 | | 1,290 | 7,770 | 1,060 | 790 | 1,090 | 375 | 450 | 435 |
| 19 | 290 | 318 | 376 | | 1,020 | 7,090 | 935 | 750 | 965 | 420 | 450 | 570 |
| 20 | 304 | 318 | 361 | | 801 | 5,660 | 835 | 730 | 830 | 435 | 450 | 1,140 |
| 21 | 304 | 262 | 346 | 304 | 714 | 4,180 | 785 | 650 | 790 | 420 | 450 | 2,380 |
| 22 | 290 | 276 | | 318 | 572 | 2,020 | 810 | 650 | 710 | 420 | 490 | 2,940 |
| 23 | 290 | 276 | | 346 | 552 | 1,140 | 1,470 | 650 | 630 | 405 | 470 | 3,180 |
| 24 | 376 | 235 | | 392 | 460 | 985 | 1,410 | 730 | 630 | 405 | 435 | 3,240 |
| 25 | 361 | 248 | | 442 | 425 | 935 | 1,080 | 730 | 670 | 405 | 390 | 2,260 |
| 26 | 318 | 290 | 325 | 514 | 442 | 835 | 785 | 670 | 670 | 435 | 420 | 1,140 |
| 27 | 376 | 235 | | 552 | 514 | 835 | 700 | 650 | 630 | 420 | 390 | 790 |
| 28 | 735 | 290 | | 632 | 592 | 700 | 680 | 650 | 570 | 420 | 360 | 670 |
| 29 | 612 | 514 | | 714 | ..... | 680 | 660 | 630 | 550 | 435 | 360 | 730 |
| 30 | 612 | 408 | | 735 | ..... | 660 | 660 | 570 | 530 | 435 | 375 | 990 |
| 31 | 552 | ..... | | 672 | ..... | 600 | ..... | 550 | ..... | 1,190 | 390 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 3,240 | 3,520 | | | | | 2,820 | 1,470 | 850 | 810 | 510 | 570 |
| 2 | 3,240 | 3,310 | | | | | 2,300 | 1,440 | 1,160 | 810 | 450 | 510 |
| 3 | 2,260 | 1,890 | | | | | 2,020 | 1,420 | 1,560 | 730 | 450 | 490 |
| 4 | 1,440 | 1,530 | | | | | 2,140 | 1,340 | 1,290 | 730 | 435 | 490 |
| 5 | 3,060 | 1,290 | | | | | 2,020 | 1,160 | 990 | 710 | 490 | 490 |
| | | | | | | 850 | | | | | | |
| 6 | 3,670 | 1,240 | | | | | 1,830 | 1,090 | 890 | 690 | 510 | 1,090 |
| 7 | 3,670 | 1,240 | | | | | 1,770 | 1,140 | 870 | 710 | 530 | 870 |
| 8 | 3,590 | 1,190 | | | | | 1,680 | 870 | 850 | 750 | 530 | 870 |
| 9 | 2,570 | 1,220 | | | | | 1,620 | 850 | 870 | 810 | 530 | 590 |
| 10 | 1,650 | 1,340 | | | | | 1,470 | 830 | 850 | 915 | 530 | 590 |
| | | | | | 750 | | | | | | | |
| 11 | 1,360 | 3,000 | | 940 | | | 2,420 | 1,320 | 850 | 810 | 730 | 490 | 610 |
| 12 | 1,190 | 2,940 | | | | | 3,450 | 1,240 | 1,140 | 790 | 690 | 510 | 590 |
| 13 | 1,090 | 2,420 | | | | | 4,460 | 1,220 | 1,160 | 770 | 670 | 530 | 550 |
| 14 | 990 | 1,740 | | | | | 4,360 | 1,190 | 1,140 | 750 | 670 | 570 | 530 |
| 15 | 965 | 1,440 | | | | | 4,270 | 1,160 | 1,040 | 1,060 | 650 | 590 | 490 |
| 16 | 990 | 1,390 | 950 | | | | 5,250 | 1,140 | 990 | 1,680 | 650 | 550 | 490 |
| 17 | 965 | 1,390 | | | | | 5,120 | 1,140 | 940 | 1,800 | 610 | 530 | 490 |
| 18 | 965 | 1,360 | | | | | 4,660 | 1,120 | 1,060 | 1,620 | 610 | 510 | 470 |
| 19 | 915 | 1,260 | | | | | 3,910 | 1,090 | 1,090 | 1,420 | 590 | 490 | 470 |
| 20 | 890 | 1,190 | | | | | 3,450 | 1,320 | 1,060 | 1,160 | 590 | 550 | 450 |
| 21 | 870 | 1,140 | | | | | 2,820 | 2,260 | 1,040 | 990 | 590 | 630 | 470 |
| 22 | 830 | 1,120 | | | | | 2,340 | 2,320 | 1,140 | 940 | 590 | 630 | 470 |
| 23 | 810 | 1,090 | | | | | 2,100 | 2,520 | 1,440 | 965 | 590 | 650 | 450 |
| 24 | 810 | 1,090 | | | | | 1,890 | 2,420 | 1,470 | 1,020 | 570 | 650 | 450 |
| 25 | 810 | 1,090 | | | | | 2,100 | 2,380 | 1,390 | 990 | 550 | 550 | 450 |
| | | | | | 620 | | | | | | | |
| 26 | 890 | 1,060 | | | | | 4,180 | 2,300 | 1,120 | 810 | 550 | 510 | 490 |
| 27 | 1,220 | 965 | | 700 | | | 4,560 | 2,180 | 990 | 750 | 530 | 510 | 550 |
| 28 | 1,190 | 965 | | | | | 4,360 | 2,060 | 915 | 750 | 510 | 490 | 490 |
| 29 | 1,190 | 915 | | | | | 4,460 | 1,920 | 890 | 750 | 490 | 530 | 470 |
| 30 | 1,190 | 870 | | | ..... | | 4,000 | 1,620 | 850 | 850 | 490 | 550 | 450 |
| 31 | 3,520 | ..... | | | ..... | | 3,520 | ..... | 850 | ..... | 530 | 570 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge of Pecatonica River at Freeport, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,330 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 735 | 243 | 339 | 0.255 | 0.29 |
| November | 514 | 235 | 313 | .235 | .26 |
| December | 757 | 276 | 396 | .298 | .34 |
| January | 735 | ..... | 380 | .286 | .33 |
| February | 1,830 | ..... | 645 | .485 | .50 |
| March | 8,790 | ..... | 2,490 | 1.87 | 2.16 |
| April | 1,470 | 560 | 847 | .637 | .71 |
| May | 3,240 | 550 | 1,030 | .774 | .89 |
| June | 1,220 | 530 | 815 | .613 | .68 |
| July | 1,190 | 375 | 530 | .398 | .46 |
| August | 1,680 | 360 | 620 | .466 | .54 |
| September | 3,240 | 330 | 952 | .716 | .80 |
| The year | 8,790 | 235 | 781 | .587 | 7.96 |
| 1919–20. | | | | | |
| October | 3,670 | 810 | 1,680 | 1.26 | 1.45 |
| November | 3,520 | 870 | 1,540 | 1.16 | 1.29 |
| December | ..... | ..... | 950 | .714 | .82 |
| January | ..... | ..... | 870 | .654 | .75 |
| February | ..... | ..... | 710 | .534 | .58 |
| March | 5,250 | ..... | 2,780 | 2.09 | 2.41 |
| April | 2,820 | 1,090 | 1,800 | 1.35 | 1.51 |
| May | 1,470 | 830 | 1,100 | .827 | .95 |
| June | 1,800 | 750 | 1,030 | .775 | .86 |
| July | 915 | 490 | 649 | .488 | .56 |
| August | 670 | 435 | 534 | .402 | .46 |
| September | 1,090 | 450 | 548 | .412 | .46 |
| The year | 5,250 | 435 | 1,180 | .887 | 12.10 |

## SUGAR RIVER NEAR BRODHEAD, WIS.

LOCATION.—In sec. 26, T. 2 N., R. 9 E., at highway bridge 2 miles southwest of Brodhead, Green County, and 12 miles above Illinois State line. Jordan Creek enters from right 2 miles below station, and Little Jordan Creek, also from right, 4 miles above.

DRAINAGE AREA.—529 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 7, 1914, to September 30, 1920.

GAGE.—Chain gage attached to upstream side of bridge; read by Arthur Christensen.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control not well defined. Right bank of medium height; seldom overflowed; left bank at gage is overflowed at stage of approximately 6.8 feet on gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.7 feet at 8.30 a. m. March 17 (discharge, about 6,380 second-feet); minimum discharge, about 60 second-feet at 6.30 p. m. September 7 (gage height, 0.90 foot).

Maximum stage recorded during year ending September 30, 1920, 6.35 feet at 8.30 a. m. October 6 (discharge, 2,520 second-feet); minimum discharge estimated 125 second-feet January 4 (stage-discharge relation affected by ice).

1914–1920: Maximum stage recorded, 11.4 feet September 13, 1915 (discharge, about 13,000 second-feet); minimum stage recorded, 0.7 foot at 5 a. m. September 8, 1918 (discharge, determined from extension of rating curve, about 54 second-feet); water was undoubtedly being held at dam at Brodhead.

REGULATION.—Operation of a power plant at Brodhead, 2 miles above station causes slight fluctuation at gage during low water, but the pondage is small and monthly discharge represents very nearly the natural flow. There are two plants farther upstream, but their operation probably has no effect on discharge at the gage.

ACCURACY.—Stage-discharge relation changed during high water of March, 1919; seriously affected by ice. Rating curve used October 1, 1918, to March 21, 1919, fairly well defined between 108 and 4,500 second-feet; curve used March 22, 1919, to September 30, 1920, fairly well defined between 80 and 510 second-feet, poorly defined outside these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period March 14–21, 1919, when indirect method for shifting channel was used, and except for periods, January 2–19, February 4–12, March 1–8, 1919, and November 28, 1919, to March 10, 1920, during which stage-discharge relation was affected by ice, for which daily discharge was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records poor for 1919 and fair for 1920.

*Discharge measurements of Sugar River near Brodhead, Wis., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 7 | H. C. Beckman | 1.49 | 228 | Dec. 16[a] | W. G. Hoyt | 2.79 | 268 |
| Dec. 10 | S. B. Soulé | 1.56 | 242 | 1920. | | | |
| 1919. | | | | Jan. 15[a] | do | 2.56 | 225 |
| Mar. 18 | do | 6.38 | 2,820 | Feb. 25[a] | S. B. Soulé | 2.35 | 249 |
| 22 | do | 2.34 | 450 | May 30 | W. G. Hoyt | 1.85 | 298 |
| May 13 | W. G. Hoyt | 1.86 | 298 | Sept. 12 | S. B. Soulé | 1.37 | 171 |
| Aug. 17 | do | 1.11 | 102 | | | | |

[a] Complete ice cover at control and measuring section.

*Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 210 | 235 | 185 | 197 | 222 | 275 | 306 | 291 | 196 | 248 | 402 | 209 |
| 2 | 150 | 197 | 235 | 195 | 197 | 195 | 276 | 276 | 336 | 222 | 491 | 132 |
| 3 | 222 | 197 | 210 | 195 | 222 | 250 | 306 | 336 | 352 | 222 | 550 | 113 |
| 4 | 210 | 248 | 306 | 195 | 220 | 250 | 306 | 710 | 368 | 196 | 336 | 151 |
| 5 | 210 | 235 | 210 | 130 | 210 | 250 | 321 | 795 | 385 | 235 | 276 | 186 |
| 6 | 124 | 235 | 222 | 195 | 210 | 250 | 248 | 710 | 306 | 183 | 306 | 183 |
| 7 | 197 | 210 | 222 | 195 | 195 | 250 | 336 | 590 | 306 | 262 | 385 | 80 |
| 8 | 162 | 210 | 222 | 195 | 195 | 250 | 352 | 550 | 235 | 321 | 321 | 180 |
| 9 | 150 | 210 | 197 | 195 | 130 | 146 | 402 | 590 | 336 | 291 | 235 | 196 |
| 10 | 197 | 173 | 222 | 195 | 175 | 210 | 510 | 472 | 291 | 222 | 209 | 196 |
| 11 | 197 | 210 | 276 | 195 | 175 | 875 | 472 | 321 | 248 | 306 | 222 | 191 |
| 12 | 222 | 197 | 405 | 150 | 175 | 1,060 | 402 | 336 | 352 | 276 | 276 | 306 |
| 13 | 150 | 222 | 338 | 220 | 185 | 1,240 | 321 | 306 | 419 | 175 | 248 | 276 |
| 14 | 173 | 222 | 306 | 220 | 262 | 1,590 | 385 | 306 | 419 | 209 | 235 | 158 |
| 15 | 173 | 222 | 248 | 220 | 740 | 1,920 | 436 | 291 | 291 | 248 | 235 | 222 |
| 16 | 185 | 210 | 262 | 220 | 660 | 3,900 | 550 | 336 | 336 | 209 | 209 | 222 |
| 17 | 222 | 197 | 222 | 220 | 405 | 6,090 | 590 | 321 | 321 | 222 | 148 | 235 |
| 18 | 262 | 222 | 248 | 220 | 322 | 2,490 | 590 | 209 | 291 | 209 | 222 | 222 |
| 19 | 222 | 222 | 248 | 150 | 197 | 1,340 | 510 | 291 | 291 | 191 | 222 | 248 |
| 20 | 150 | 235 | 222 | 222 | 235 | 875 | 336 | 291 | 276 | 165 | 175 | 336 |
| 21 | 185 | 222 | 248 | 197 | 210 | 545 | 402 | 262 | 248 | 156 | 222 | 550 |
| 22 | 197 | 197 | 173 | 222 | 248 | 454 | 385 | 262 | 235 | 222 | 235 | 1,410 |
| 23 | 222 | 222 | 276 | 222 | 162 | 385 | 321 | 248 | 276 | 248 | 235 | 1,580 |
| 24 | 262 | 173 | 248 | 222 | 210 | 402 | 306 | 248 | 276 | 196 | 136 | 1,020 |
| 25 | 185 | 197 | 222 | 248 | 276 | 368 | 306 | 196 | 248 | 196 | 222 | 472 |
| 26 | 235 | 210 | 222 | 248 | 306 | 385 | 248 | 276 | 235 | 180 | 248 | 352 |
| 27 | 276 | 235 | 248 | 291 | 276 | 368 | 235 | 262 | 262 | 173 | 222 | 276 |
| 28 | 440 | 84 | 248 | 338 | 276 | 336 | 306 | 248 | 248 | 191 | 248 | 209 |
| 29 | 510 | 162 | 173 | 248 | ..... | 306 | 291 | 235 | 158 | 196 | 222 | 321 |
| 30 | 405 | 248 | 222 | 222 | ..... | 262 | 306 | 222 | 209 | 191 | 170 | 472 |
| 31 | 276 | ..... | 248 | 222 | ..... | 321 | ..... | 262 | ..... | 222 | 98 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 750 | 1,520 | 305 | 250 | 260 | 250 | 630 | 550 | 306 | 336 | 180 | 235 |
| 2 | 930 | 1,410 | 305 | 250 | 320 | 250 | 710 | 510 | 336 | 291 | 235 | 222 |
| 3 | 840 | 930 | 305 | 210 | 320 | 250 | 385 | 510 | 402 | 291 | 248 | 222 |
| 4 | 885 | 590 | 305 | 125 | 335 | 250 | 670 | 402 | 368 | 262 | 235 | 196 |
| 5 | 2,360 | 436 | 305 | 275 | 350 | 260 | 510 | 368 | 306 | 276 | 183 | 196 |
| 6 | 2,420 | 419 | 290 | 220 | 350 | 260 | 510 | 352 | 262 | 321 | 188 | 248 |
| 7 | 1,520 | 436 | 210 | 220 | 350 | 290 | 419 | 352 | 291 | 321 | 183 | 248 |
| 8 | 1,020 | 472 | 290 | 235 | 305 | 305 | 419 | 352 | 291 | 336 | 209 | 222 |
| 9 | 710 | 402 | 290 | 260 | 335 | 335 | 402 | 321 | 306 | 336 | 248 | 235 |
| 10 | 491 | 630 | 290 | 275 | 305 | 370 | 402 | 336 | 276 | 336 | 235 | 235 |
| 11 | 472 | 795 | 290 | 180 | 370 | 840 | 402 | 352 | 291 | 306 | 209 | 222 |
| 12 | 352 | 930 | 275 | 235 | 220 | 2,120 | 419 | 352 | 276 | 321 | 235 | 186 |
| 13 | 402 | 750 | 275 | 250 | 335 | 2,360 | 419 | 402 | 235 | 306 | 276 | 222 |
| 14 | 368 | 590 | 185 | 275 | 320 | 2,000 | 402 | 368 | 402 | 276 | 291 | 235 |
| 15 | 368 | 510 | 275 | 220 | 175 | 1,820 | 419 | 336 | 550 | 276 | 276 | 235 |
| 16 | 368 | 352 | 270 | 250 | 220 | 1,700 | 454 | 306 | 795 | 262 | 276 | 235 |
| 17 | 402 | 402 | 235 | 290 | 250 | 1,460 | 419 | 336 | 1,110 | 276 | 248 | 222 |
| 18 | 436 | 402 | 250 | 190 | 260 | 1,160 | 368 | 336 | 1,060 | 222 | 235 | 180 |
| 19 | 321 | 385 | 250 | 260 | 290 | 885 | 436 | 385 | 1,160 | 248 | 222 | 156 |
| 20 | 368 | 385 | 250 | 290 | 250 | 670 | 840 | 385 | 930 | 248 | 209 | 186 |
| 21 | 321 | 402 | 210 | 275 | 220 | 630 | 1,110 | 368 | 491 | 276 | 248 | 175 |
| 22 | 336 | 368 | 275 | 290 | 210 | 670 | 1,160 | 352 | 436 | 248 | 209 | 209 |
| 23 | 336 | 352 | 260 | 275 | 260 | 630 | 930 | 385 | 436 | 262 | 306 | 209 |
| 24 | 336 | 402 | 275 | 250 | 260 | 670 | 590 | 436 | 472 | 235 | 248 | 191 |
| 25 | 352 | 368 | 275 | 185 | 250 | 840 | 454 | 590 | 385 | 191 | 222 | 175 |
| 26 | 436 | 368 | 275 | 305 | 250 | 2,180 | 472 | 402 | 368 | 248 | 248 | 170 |
| 27 | 630 | 306 | 250 | 305 | 250 | 2,360 | 510 | 336 | 306 | 222 | 248 | 222 |
| 28 | 491 | 305 | 250 | 305 | 250 | 1,410 | 590 | 321 | 291 | 235 | 235 | 209 |
| 29 | 419 | 305 | 250 | 290 | 250 | 1,260 | 550 | 291 | 352 | 222 | 209 | 183 |
| 30 | 436 | 220 | 275 | 320 | ..... | 975 | 550 | 276 | 336 | 222 | 248 | 196 |
| 31 | 840 | ..... | 260 | 370 | ..... | 795 | ..... | 306 | ..... | 235 | 209 | ..... |

*Monthly discharge of Sugar River near Brodhead, Wis., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 529 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 510 | 124 | 225 | 0.425 | 0.49 |
| November | 248 | 84 | 209 | .395 | .44 |
| December | 405 | 173 | 243 | .459 | .53 |
| January | 338 | 130 | 213 | .403 | .46 |
| February | 740 | 130 | 261 | .493 | .51 |
| March | 6,090 | 145 | 898 | 1.70 | 1.96 |
| April | 590 | 235 | 369 | .698 | .78 |
| May | 795 | 196 | 356 | .673 | .78 |
| June | 419 | 158 | 292 | .552 | .62 |
| July | 321 | 156 | 219 | .414 | .48 |
| August | 550 | 98 | 257 | .486 | .56 |
| September | 1,580 | 80 | 357 | .675 | .75 |
| The year | 6,090 | 80 | 326 | .616 | 8.36 |
| 1919–20. | | | | | |
| October | 2,420 | 321 | 668 | 1.26 | 1.45 |
| November | 1,520 | 220 | 538 | 1.02 | 1.14 |
| December | 305 | 185 | 268 | .507 | .58 |
| January | 370 | 125 | 256 | .484 | .56 |
| February | 370 | 175 | 280 | .529 | .57 |
| March | 2,360 | 250 | 976 | 1.84 | 2.12 |
| April | 1,160 | 368 | 552 | 1.04 | 1.16 |
| May | 590 | 276 | 377 | .713 | .82 |
| June | 1,160 | 235 | 451 | .871 | .97 |
| July | 336 | 191 | 272 | .514 | .59 |
| August | 306 | 180 | 234 | .442 | .51 |
| September | 248 | 156 | 209 | .395 | .44 |
| The year | 2,420 | 125 | 425 | .803 | 10.91 |

*Days of deficiency in discharge of Sugar River near Brodhead, Wis., for the years ending Sept. 30, 1915–1920.*

| Discharge in second-feet. | Days of deficient discharge. | | | | | | Oct. 1, 1914, to Sept. 30, 1920. | |
|---|---|---|---|---|---|---|---|---|
| | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | Total days. | Per cent of time. |
| 60 | ..... | ..... | ..... | 0 | ..... | ..... | 0 | 0.0 |
| 70 | ..... | ..... | 0 | 1 | 0 | ..... | 1 | .1 |
| 85 | ..... | ..... | 1 | 4 | 2 | ..... | 7 | .3 |
| 100 | 0 | ..... | 1 | 8 | 3 | ..... | 12 | .5 |
| 120 | 1 | ..... | 3 | 16 | 4 | 0 | 24 | 1.1 |
| 140 | 1 | ..... | 14 | 31 | 9 | 1 | 56 | 2.6 |
| 160 | 28 | 0 | 47 | 48 | 20 | 2 | 145 | 6.6 |
| 180 | 30 | 2 | 84 | 67 | 40 | 6 | 229 | 10.5 |
| 200 | 44 | 2 | 89 | 106 | 87 | 23 | 351 | 16.0 |
| 220 | 57 | 10 | 94 | 133 | 119 | 36 | 449 | 20.5 |
| 240 | 99 | 32 | 128 | 176 | 185 | 75 | 695 | 31.7 |
| 260 | 128 | 57 | 158 | 203 | 221 | 111 | 878 | 40.1 |
| 280 | 154 | 93 | 208 | 242 | 251 | 150 | 1,098 | 50.1 |
| 300 | 197 | 110 | 228 | 262 | 262 | 169 | 1,228 | 56.0 |
| 325 | 229 | 139 | 256 | 286 | 291 | 203 | 1,404 | 64.1 |
| 350 | 239 | 177 | 269 | 292 | 304 | 221 | 1,502 | 68.5 |
| 400 | 264 | 234 | 287 | 309 | 317 | 259 | 1,670 | 76.2 |
| 500 | 291 | 286 | 316 | 320 | 335 | 300 | 1,848 | 84.3 |
| 700 | 321 | 323 | 334 | 329 | 348 | 324 | 1,979 | 90.2 |
| 1,000 | 342 | 345 | 347 | 340 | 354 | 344 | 2,072 | 94.5 |
| 1,500 | 348 | 354 | 359 | 348 | 359 | 355 | 2,123 | 96.9 |
| 2,500 | 358 | 360 | 364 | 360 | 363 | 366 | 2,171 | 99.0 |
| 5,000 | 364 | 364 | 365 | 365 | 364 | ..... | 2,188 | 99.8 |
| 9,000 | 365 | 366 | ..... | ..... | 365 | ..... | 2,192 | 100.0 |
| Mean discharge (sec.-ft.) | 464 | 498 | 356 | 388 | 326 | 425 | ..... | ..... |
| Maximum (sec.-ft.) | 8,600 | 6,090 | 2,710 | 4,350 | 6,090 | 2,420 | ..... | ..... |
| Minimum (sec.-ft.) | 108 | 168 | 85 | 70 | 80 | 125 | ..... | ..... |

### IOWA RIVER AT MARSHALLTOWN, IOWA.

LOCATION.—In sec. 23, T. 84 N., R. 18 W., at Third Avenue highway bridge, 1 mile north of Marshalltown, Marshall County, and 1 mile below site of old gaging station. Asher Creek enters from left 1 mile above station, Burnett Creek from left 1 mile below, and Linn Creek from right 2 miles below.

DRAINAGE AREA.—1,380 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 21, 1915, to September 30, 1920. February 23, 1903, to August 8, 1903, from old site 1 mile above present station.

GAGE.—Chain gage attached to downstream handrail of bridge, 60 feet from right pier; read by B. S. Beehrle.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; subject to shift. Banks subject to overflow, the left bank at stages above 13 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year ending September 30, 1919, 12.74 feet at 12.10 p. m. March 17 (discharge, 7,030 second-feet); minimum stage, 2.00 feet at 12.30 p. m. September 13 (discharge, 80 second-feet).

Maximum stage recorded during year ending September 30, 1920, 12.35 feet October 6 (discharge, 6,450 second-feet); minimum discharge, estimated 130 second-feet February 19, 21, 26, and 27 (stage-discharge relation affected by ice).

1915–1920: Maximum stage recorded, 17.74 feet June 4, 1918 (discharge, 42,000 second-feet); minimum stage, 1.86 feet November 24, 1917 (discharge, about 2 second-feet).

ICE.—Stage-discharge relation affected by ice for short periods during extremely cold weather.

REGULATION.—Operation of a power plant at Eldora about 25 miles upstream causes slight diurnal fluctuation at gage during periods of low water.

ACCURACY.—Stage-discharge relation practically permanent for medium and high stages; changed for low stages during ice break-up in March, 1920; seriously affected by ice. Rating curve used October 1, 1918, to March 5, 1920, well defined throughout; curve used March 6 to September 30, 1920, is a revision of former curve at low-water end and is well defined throughout. Gage read to hundredths once daily or oftener during floods, except August 22 to November 5, 1919, when bridge was being repaired, during which period observations were discontinued from August 22 to September 7, and readings were obtained from a temporary gage September 8 to November 5. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Iowa River at Marshalltown, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 15 | H. C. Beckman | 2.58 | 159 | Jan. 6[a] | E. D. Burchard | 3.11 | 243 |
| | | | | 29[a] | do | 3.10 | 175 |
| 1919. | | | | Mar. 3[a] | do | 4.57 | 645 |
| Mar. 24 | R. H. Bolster | 6.30 | 1,690 | 15 | do | 8.00 | 2,810 |
| May 16 | E. D. Burchard | 5.02 | 1,260 | May 21[b] | do | 5.37 | 1,350 |
| June 9 | do | 6.12 | 1,810 | Aug. 4 | do | 2.51 | 212 |
| July 21 | do | 2.83 | 239 | | | | |
| Sept. 8 | do | 2.05 | 84.2 | | | | |
| Dec. 12[a] | do | 3.62 | 373 | | | | |

[a] Measurement made through ice.

[b] Measurement made from boat.

*Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 168 | 838 | 341 | 280 | 417 | 265 | 1,070 | 1,690 | 455 | 670 | 131 | 88 |
| 2 | 146 | 882 | 303 | 280 | 436 | 360 | 1,070 | 1,910 | 882 | 590 | 129 | 90 |
| 3 | 146 | 838 | 417 | 320 | 436 | 400 | 882 | 2,020 | 1,470 | 512 | 168 | 84 |
| 4 | 146 | 752 | 417 | 320 | 341 | 380 | 882 | 3,060 | 1,740 | 474 | 156 | 82 |
| 5 | 146 | 882 | 379 | 320 | 210 | 400 | 882 | 3,840 | 1,640 | 474 | 113 | 86 |
| 6 | 129 | 590 | 379 | 340 | 240 | 360 | 838 | 2,840 | 1,740 | 417 | 133 | 88 |
| 7 | 126 | 550 | 398 | 310 | 210 | 380 | 838 | 2,570 | 1,740 | 398 | 156 | 90 |
| 8 | 136 | 512 | 417 | 310 | 260 | 400 | 1,070 | 2,350 | 1,740 | 360 | 122 | 90 |
| 9 | 133 | 436 | 436 | 320 | 320 | 420 | 1,910 | 2,400 | 1,710 | 360 | 119 | 95 |
| 10 | 126 | 474 | 670 | 340 | 310 | 436 | 2,960 | 2,520 | 2,180 | 1,540 | 116 | 93 |
| 11 | 131 | 512 | 710 | 340 | 320 | 512 | 3,490 | 2,180 | 3,000 | 630 | 111 | 90 |
| 12 | 129 | 512 | 838 | 310 | 320 | 590 | 5,060 | 2,130 | 2,520 | 455 | 108 | 81 |
| 13 | 133 | 455 | 974 | 320 | 360 | 590 | 5,500 | 1,420 | 2,130 | 417 | 417 | 80 |
| 14 | 146 | 455 | 1,020 | 320 | 1,020 | 670 | 6,110 | 1,320 | 2,180 | 379 | 156 | 85 |
| 15 | 156 | 455 | 1,020 | 322 | 928 | 928 | 5,860 | 1,220 | 2,130 | 303 | 126 | 88 |
| 16 | 146 | 455 | 1,020 | 360 | 838 | 5,060 | 5,860 | 1,120 | 2,020 | 284 | 122 | 95 |
| 17 | 137 | 455 | 974 | 398 | 1,220 | 6,670 | 5,730 | 1,020 | 3,010 | 216 | 111 | 103 |
| 18 | 146 | 474 | 928 | 398 | 1,320 | 3,990 | 5,500 | 974 | 2,350 | 216 | 113 | 228 |
| 19 | 146 | 512 | 838 | 398 | 1,590 | 3,300 | 5,060 | 882 | 2,130 | 265 | 111 | 550 |
| 20 | 136 | 670 | 794 | 379 | 1,470 | 3,180 | 3,810 | 794 | 2,570 | 216 | 108 | 550 |
| 21 | 133 | 794 | 710 | 360 | 1,590 | 3,120 | 3,300 | 752 | 2,460 | 228 | 106 | 341 |
| 22 | 137 | 882 | 710 | 379 | 1,170 | 2,680 | 2,620 | 752 | 2,210 | 180 | 104 | 180 |
| 23 | 146 | 838 | 670 | 379 | 974 | 2,620 | 3,000 | 710 | 2,020 | 180 | 102 | 130 |
| 24 | 146 | 752 | 512 | 398 | 882 | 1,800 | 3,000 | 670 | 2,520 | 168 | 100 | 121 |
| 25 | 133 | 512 | 455 | 436 | 455 | 1,640 | 2,080 | 670 | 2,350 | 156 | 100 | 100 |
| 26 | 146 | 455 | 417 | 474 | 398 | 1,470 | 1,910 | 590 | 1,800 | 146 | 96 | 98 |
| 27 | 168 | 436 | 341 | 512 | 379 | 1,370 | 1,740 | 590 | 1,270 | 146 | 98 | 95 |
| 28 | 265 | 341 | 216 | 512 | 322 | 1,320 | 1,610 | 512 | 710 | 134 | 96 | 93 |
| 29 | 512 | 265 | 210 | 512 | ..... | 1,270 | 1,420 | 512 | 794 | 129 | 94 | 91 |
| 30 | 670 | 265 | 260 | 455 | ..... | 1,170 | 1,470 | 474 | 752 | 127 | 94 | 341 |
| 31 | 882 | ..... | 280 | 398 | ..... | 1,120 | ..... | 455 | ..... | 130 | 92 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 228 | 710 | 380 | 300 | 180 | 150 | 1,710 | 2,350 | 730 | 350 | 212 | 438 |
| 2 | 195 | 550 | 360 | 280 | 180 | 170 | 2,180 | 2,180 | 850 | 438 | 230 | 438 |
| 3 | 838 | 474 | 310 | 260 | 170 | 190 | 1,710 | 2,080 | 730 | 530 | 218 | 455 |
| 4 | 1,120 | 417 | 320 | 260 | 170 | 2,000 | 1,610 | 1,760 | 650 | 570 | 205 | 472 |
| 5 | 1,320 | 360 | 280 | 260 | 180 | 1,700 | 1,260 | 1,560 | 650 | 985 | 285 | 490 |
| 6 | 4,870 | 322 | 210 | 210 | 190 | 1,610 | 1,080 | 1,360 | 650 | 985 | 350 | 490 |
| 7 | 1,540 | 322 | 260 | 280 | 190 | 1,260 | 1,030 | 1,210 | 570 | 985 | 270 | 490 |
| 8 | 710 | 284 | 280 | 210 | 180 | 1,120 | 940 | 1,080 | 570 | 1,030 | 212 | 490 |
| 9 | 670 | 2,520 | 300 | 220 | 180 | 1,460 | 940 | 985 | 530 | 895 | 285 | 1,960 |
| 10 | 550 | 2,960 | 300 | 200 | 170 | 2,300 | 850 | 895 | 490 | 985 | 230 | 2,960 |
| 11 | 512 | 3,990 | 360 | 190 | 170 | 2,620 | 850 | 850 | 455 | 940 | 205 | 2,180 |
| 12 | 474 | 2,180 | 380 | 200 | 140 | 3,420 | 850 | 2,020 | 420 | 1,080 | 205 | 2,020 |
| 13 | 436 | 1,910 | 380 | 210 | 140 | 3,010 | 810 | 2,790 | 385 | 1,160 | 218 | 1,960 |
| 14 | 360 | 1,470 | 380 | 220 | 140 | 2,210 | 850 | 2,570 | 350 | 1,210 | 212 | 1,960 |
| 15 | 341 | 1,070 | 360 | 260 | 140 | 2,740 | 810 | 2,180 | 385 | 1,120 | 218 | 1,560 |
| 16 | 322 | 1,070 | 340 | 210 | 150 | 2,460 | 985 | 1,960 | 420 | 985 | 218 | 1,460 |
| 17 | 303 | 974 | 320 | 220 | 140 | 2,020 | 1,120 | 1,860 | 402 | 1,210 | 185 | 1,410 |
| 18 | 284 | 882 | 320 | 200 | 140 | 1,760 | 985 | 1,710 | 350 | 1,160 | 185 | 1,160 |
| 19 | 265 | 838 | 260 | 200 | 130 | 2,180 | 895 | 2,020 | 332 | 985 | 175 | 850 |
| 20 | 246 | 838 | 280 | 190 | 110 | 2,020 | 1,410 | 1,560 | 530 | 895 | 165 | 730 |
| 21 | 228 | 752 | 300 | 180 | 130 | 1,910 | 1,760 | 1,360 | 730 | 1,080 | 402 | 530 |
| 22 | 210 | 670 | 300 | 170 | 140 | 1,760 | 1,860 | 1,460 | 650 | 1,030 | 650 | 530 |
| 23 | 195 | 670 | 320 | 170 | 140 | 1,260 | 1,810 | 1,460 | 570 | 850 | 455 | 530 |
| 24 | 180 | 710 | 320 | 160 | 140 | 1,310 | 1,760 | 1,460 | 472 | 690 | 650 | 570 |
| 25 | 512 | 670 | 340 | 160 | 140 | 1,460 | 1,710 | 1,360 | 455 | 570 | 895 | 490 |
| 26 | 417 | 590 | 340 | 180 | 130 | 2,900 | 1,660 | 1,310 | 402 | 455 | 985 | 490 |
| 27 | 284 | 265 | 360 | 190 | 130 | 3,420 | 1,610 | 1,460 | 332 | 385 | 985 | 472 |
| 28 | 246 | 260 | 340 | 190 | 140 | 2,740 | 1,760 | 1,260 | 285 | 350 | 940 | 472 |
| 29 | 265 | 280 | 340 | 180 | 140 | 2,300 | 1,710 | 1,160 | 385 | 350 | 850 | 455 |
| 30 | 303 | 300 | 340 | 180 | ..... | 2,180 | 1,960 | 1,030 | 385 | 285 | 650 | 455 |
| 31 | 474 | ..... | 360 | 180 | ..... | 1,660 | ..... | 850 | ..... | 255 | 402 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 29, 1918, to Jan. 14, 1919, Feb. 6–13, Mar. 2–9, 1919, and Nov. 28, 1919, to Mar. 5, 1920: discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Observations discontinued on account of bridge being repaired, Aug. 22 to Sept. 7, 1919; discharge ascertained by comparison with flow of Iowa River at Iowa City, Shellrock River near Clarksville, and Raccoon River at Van Meter. Mean discharge for days of sudden change in stage, was ascertained by integrating a hydrograph of several gage readings obtained during such days.

*Monthly discharge of Iowa River at Marshalltown, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,380 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 882 | 126 | 198 | 0.143 | 0.16 |
| November | 882 | 265 | 575 | .417 | .47 |
| December | 1,020 | 240 | 584 | .423 | .49 |
| January | 512 | 280 | 374 | .271 | .31 |
| February | 1,590 | 210 | 671 | .486 | .51 |
| March | 6,670 | 265 | 1,580 | 1.14 | 1.31 |
| April | 6,110 | 838 | 2,890 | 2.09 | 2.33 |
| May | 3,840 | 455 | 1,450 | 1.05 | 1.21 |
| June | 3,010 | 455 | 1,880 | 1.36 | 1.52 |
| July | 1,540 | 127 | 355 | .257 | .30 |
| August | 417 | 92 | 126 | .091 | .10 |
| September | 550 | 80 | 148 | .107 | .12 |
| The year | 6,670 | 80 | 898 | .651 | 8.83 |
| 1919–20. | | | | | |
| October | 4,870 | 180 | 610 | .442 | .51 |
| November | 3,990 | 260 | 977 | .708 | .79 |
| December | 380 | 240 | 326 | .236 | .27 |
| January | 300 | 160 | 214 | .155 | .18 |
| February | 190 | 130 | 153 | .111 | .12 |
| March | 3,420 | 150 | 1,910 | 1.38 | 1.59 |
| April | 2,180 | 810 | 1,350 | .978 | 1.09 |
| May | 2,790 | 850 | 1,590 | 1.15 | 1.33 |
| June | 850 | 285 | 504 | .365 | .41 |
| July | 1,210 | 255 | 800 | .580 | .67 |
| August | 985 | 165 | 401 | .291 | .34 |
| September | 2,960 | 438 | 966 | .700 | .78 |
| The year | 4,870 | 130 | 819 | .593 | 8.08 |

### IOWA RIVER AT IOWA CITY, IOWA.

LOCATION.—In sec. 15, T. 79 N., R. 6 W., at highway bridge 500 feet below Chicago, Rock Island & Pacific Railway main-line bridge in Iowa City, Johnson County, three-quarters of a mile below Iowa State University's power plant, and three quarters of a mile downstream from old station, which was at county highway bridge a short distance above dam.

DRAINAGE AREA.—3,140 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 30, 1913, to September 30, 1920; June 1, 1903, to July 21, 1906, from gaging station three-quarters of a mile upstream.

GAGE.—Chain gage attached to upstream handrail of bridge about 40 feet from left pier of first span from left bank; read by Albert Kostal.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or from a boat about 1,000 feet downstream from bridge.

CHANNEL AND CONTROL.—Bed composed of sand; shifting. Right bank high and not subject to overflow; left bank subject to overflow at ordinary high stages under a pile trestle approach to the bridge and at extreme high stages beyond left end of the approach also.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 11.6 feet at 9.40 a. m. May 7 (discharge, 12,800 second-feet); minimum stage, 0.38 foot at 1.30 p. m. September 13 (discharge, 79 second-feet).

Maximum stage recorded during year ending September 30, 1920, 9.3 feet March 17 and 18 (discharge, 8,130 second-feet); minimum stage, 0.60 foot August 17 (discharge, 280 second-feet).

1903–1906 and 1913–1920: Maximum stage recorded, 19.45 feet June 7, 1918 (discharge, 36,200 second-feet); minimum discharge about 10 second-feet December 26, 1916.

ICE.—Stage-discharge relation affected by ice, observations discontinued during periods of ice effect.

REGULATION.—Considerable diurnal fluctuation is caused at low stages, owing to operation of power plant above station.

ACCURACY.—Stage-discharge relation changed during flood of early October, 1919; affected by ice. Two well defined rating curves used; one is applicable October 1, 1918, to September 30, 1919, and the other, which is a revision of the former curve below gage height 8.6 feet (discharge, 7,080 second-feet) is applicable October 1, 1919, to September 30, 1920. Gage read to hundredths once daily except during frozen periods, January 1–21, 1919, and December 16, 1919, to January 29, 1920. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good except for low-water periods during which considerable diurnal fluctuation occurred, for which they are fair; winter records fair.

*Discharge measurements of Iowa River at Iowa City, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 11 | H. C. Beckman | 1.17 | 267 | Nov. 17 | E. D. Burchard | 5.80 | 4,160 |
| 1919. | | | | 1920. | | | |
| Mar. 21 | R. H. Bolstar | 8.98 | 7,560 | Jan. 30[a] | do | 2.26 | 579 |
| May 9 | E. D. Burchard | 10.30 | 9,960 | May 25 | do | 6.41 | 4,960 |
| Sept. 12 | do | .60 | 162 | Aug. 7 | do | 1.26 | 643 |

[a] Measurement made through ice.

*Daily discharge, in second-feet, of Iowa River at Iowa City, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 372 | 580 | 640 | 600 | 1,050 | 610 | 2,680 | 4,570 | 1,780 | 2,430 | 540 | 218 |
| 2 | 345 | 610 | 580 | 650 | 980 | 262 | 2,600 | 4,210 | 4,760 | 2,100 | 510 | 290 |
| 3 | 318 | 580 | 610 | 660 | 705 | 980 | 2,430 | 7,360 | 4,210 | 2,020 | 428 | 228 |
| 4 | 318 | 640 | 640 | 500 | 640 | 1,490 | 2,430 | 8,300 | 5,670 | 1,780 | 570 | 205 |
| 5 | 318 | 770 | 610 | 420 | 580 | 1,340 | 2,430 | 7,220 | 6,520 | 2,100 | 570 | 241 |
| 6 | 318 | 980 | 640 | 650 | 550 | 1,190 | 2,340 | 7,810 | 6,940 | 1,940 | 570 | 218 |
| 7 | 318 | 910 | 705 | 650 | 400 | 1,260 | 2,340 | 12,800 | 6,940 | 1,780 | 660 | 218 |
| 8 | 318 | 910 | 640 | 650 | 550 | 1,410 | 2,340 | 12,500 | 6,800 | 1,860 | 630 | 228 |
| 9 | 262 | 840 | 910 | 650 | 520 | 1,490 | 2,430 | 10,200 | 6,940 | 1,480 | 660 | 205 |
| 10 | 235 | 705 | 840 | 700 | 550 | 2,340 | 3,400 | 10,400 | 6,140 | 1,340 | 428 | 174 |
| 11 | 208 | 770 | 980 | 700 | 580 | 2,880 | 3,850 | 9,750 | 4,950 | 1,340 | 540 | 241 |
| 12 | 318 | 705 | 980 | 500 | 640 | 5,430 | 4,120 | 6,520 | 5,050 | 1,480 | 600 | 228 |
| 13 | 345 | 705 | 1,050 | 700 | 1,120 | 4,060 | 4,210 | 5,150 | 5,560 | 1,480 | 570 | 79 |
| 14 | 318 | 640 | 1,050 | 650 | 1,820 | 3,330 | 4,760 | 4,660 | 5,050 | 1,700 | 750 | 196 |
| 15 | 318 | 770 | 980 | 650 | 1,730 | 3,240 | 4,950 | 4,300 | 4,390 | 1,410 | 1,200 | 228 |
| 16 | 318 | 640 | 1,050 | 700 | 1,900 | 8,820 | 5,350 | 3,760 | 4,210 | 1,270 | 1,140 | 140 |
| 17 | 262 | 580 | 1,050 | 700 | 1,650 | 6,800 | 5,780 | 3,580 | 4,570 | 1,200 | 780 | 174 |
| 18 | 290 | 640 | 1,120 | 650 | 1,490 | 6,800 | 6,260 | 3,130 | 4,390 | 1,140 | 750 | 241 |
| 19 | 318 | 610 | 1,190 | 550 | 1,490 | 8,470 | 6,520 | 2,860 | 4,390 | 1,140 | 660 | 340 |
| 20 | 372 | 840 | 1,260 | 650 | 1,650 | 9,000 | 6,940 | 2,860 | 4,480 | 810 | 600 | 720 |
| 21 | 345 | 705 | 1,260 | 750 | 1,730 | 7,660 | 6,660 | 2,270 | 4,210 | 1,070 | 540 | 1,340 |
| 22 | 290 | 705 | 1,490 | 980 | 1,980 | 6,800 | 6,390 | 2,680 | 3,850 | 660 | 455 | 1,550 |
| 23 | 290 | 705 | 1,900 | 1,050 | 1,820 | 6,800 | 7,270 | 2,430 | 3,850 | 810 | 350 | 1,270 |
| 24 | 318 | 705 | 1,490 | 1,190 | 1,980 | 5,900 | 6,800 | 2,340 | 4,660 | 690 | 375 | 940 |
| 25 | 235 | 640 | 705 | 1,190 | 1,820 | 5,050 | 6,260 | 2,180 | 5,350 | 780 | 340 | 842 |
| 26 | 208 | 640 | 580 | 1,050 | 1,050 | 4,300 | 6,520 | 2,100 | 4,950 | 810 | 290 | 660 |
| 27 | 430 | 610 | 610 | 1,120 | 910 | 3,670 | 7,510 | 2,020 | 5,050 | 630 | 400 | 482 |
| 28 | 262 | 640 | 580 | 1,190 | 770 | 3,490 | 7,080 | 1,780 | 5,050 | 660 | 340 | 510 |
| 29 | 372 | 640 | 550 | 1,190 | ..... | 3,130 | 5,450 | 1,780 | 3,400 | 600 | 275 | 660 |
| 30 | 640 | 610 | 550 | 1,120 | ..... | 3,040 | 4,660 | 1,780 | 2,680 | 630 | 325 | 540 |
| 31 | 640 | ..... | 600 | 1,050 | ..... | 2,880 | ..... | 1,620 | ..... | 690 | 315 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 1,210 | 1,560 | 1,500 | 1,100 | 600 | 600 | 6,000 | 4,360 | 2,520 | 1,420 | 760 | 1,010 |
| 2 | 3,020 | 1,860 | 1,300 | 1,000 | 550 | 700 | 6,820 | 4,270 | 2,520 | 1,560 | 945 | 1,010 |
| 3 | 4,000 | 2,260 | 1,100 | 950 | 600 | 800 | 5,600 | 4,270 | 2,680 | 1,350 | 820 | 880 |
| 4 | 4,360 | 1,780 | 1,100 | 900 | 600 | 1,000 | 5,500 | 4,270 | 2,260 | 1,080 | 700 | 820 |
| 5 | 2,940 | 1,710 | 1,100 | 850 | 600 | 1,400 | 5,120 | 4,180 | 2,180 | 1,140 | 672 | 645 |
| 6 | 2,380 | 1,780 | 1,100 | 850 | 600 | 1,900 | 4,450 | 3,910 | 1,940 | 2,600 | 645 | 820 |
| 7 | 3,820 | 1,640 | 1,200 | 800 | 650 | 2,800 | 3,550 | 3,730 | 2,020 | 3,370 | 618 | 1,010 |
| 8 | 4,270 | 1,490 | 1,200 | 800 | 550 | 2,600 | 3,370 | 3,280 | 2,100 | 3,560 | 618 | 1,010 |
| 9 | 4,270 | 1,780 | 1,300 | 800 | 600 | 2,600 | 3,280 | 3,020 | 2,020 | 2,520 | 672 | 945 |
| 10 | 3,460 | 3,110 | 1,400 | 800 | 850 | 2,400 | 2,940 | 2,860 | 1,860 | 2,100 | 780 | 945 |
| 11 | 2,520 | 5,210 | 1,300 | 850 | 900 | 2,400 | 2,860 | 2,680 | 1,710 | 1,940 | 730 | 945 |
| 12 | 2,260 | 4,920 | 1,300 | 850 | 900 | 2,200 | 2,680 | 3,910 | 1,420 | 1,840 | 945 | 1,490 |
| 13 | 1,940 | 6,570 | 1,300 | 850 | 950 | 2,400 | 2,680 | 5,400 | 1,350 | 1,780 | 672 | 2,260 |
| 14 | 1,710 | 5,900 | 1,300 | 850 | 900 | 2,800 | 2,600 | 5,560 | 1,350 | 1,780 | 562 | 2,180 |
| 15 | 1,640 | 6,000 | 1,200 | 850 | 850 | 3,200 | 2,600 | 6,000 | 1,280 | 1,780 | 508 | 2,100 |
| 16 | 1,640 | 5,120 | 1,200 | 850 | 800 | 7,360 | 2,520 | 6,450 | 1,210 | 1,780 | 562 | 2,020 |
| 17 | 1,490 | 4,000 | 1,200 | 850 | 800 | 8,130 | 2,600 | 6,330 | 1,140 | 2,020 | 280 | 1,860 |
| 18 | 1,420 | 3,460 | 1,200 | 800 | 700 | 8,130 | 2,680 | 5,700 | 1,140 | 1,940 | 508 | 1,710 |
| 19 | 1,350 | 3,110 | 1,100 | 800 | 650 | 6,330 | 3,640 | 5,120 | 1,140 | 1,710 | 535 | 1,640 |
| 20 | 1,280 | 3,020 | 1,100 | 750 | 650 | 5,120 | 4,830 | 4,450 | 1,080 | 1,860 | 562 | 1,560 |
| 21 | 1,280 | 2,860 | 1,100 | 700 | 600 | 4,540 | 4,920 | 4,360 | 1,080 | 1,780 | 535 | 1,420 |
| 22 | 1,210 | 2,770 | 1,100 | 700 | 600 | 4,360 | 5,600 | 4,180 | 1,140 | 1,560 | 535 | 1,350 |
| 23 | 1,210 | 2,520 | 1,100 | 700 | 550 | 4,180 | 6,330 | 3,820 | 1,140 | 1,420 | 1,140 | 1,210 |
| 24 | 1,080 | 2,430 | 1,100 | 650 | 600 | 4,000 | 6,110 | 3,910 | 1,210 | 1,490 | 880 | 1,080 |
| 25 | 1,210 | 2,430 | 1,100 | 650 | 550 | 6,000 | 4,920 | 4,640 | 1,280 | 1,490 | 760 | 1,010 |
| 26 | 1,210 | 2,180 | 1,100 | 600 | 550 | 7,660 | 4,270 | 4,540 | 1,280 | 1,280 | 820 | 945 |
| 27 | 1,280 | 2,200 | 1,100 | 600 | 600 | 6,330 | 4,360 | 3,640 | 1,140 | 1,210 | 730 | 880 |
| 28 | 1,210 | 2,000 | 1,100 | 600 | 600 | 6,450 | 4,360 | 2,940 | 1,010 | 1,140 | 880 | 760 |
| 29 | 1,280 | 1,900 | 1,100 | 600 | 600 | 6,820 | 4,540 | 2,940 | 1,140 | 1,010 | 945 | 730 |
| 30 | 1,350 | 1,600 | 1,100 | 600 | ..... | 6,820 | 4,640 | 2,770 | 1,140 | 760 | 1,140 | 590 |
| 31 | 1,350 | ..... | 1,100 | 600 | ..... | 6,110 | ..... | 2,680 | ..... | 880 | 1,210 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 31, 1918, to Jan. 21, 1919; discharge ascertained by means of records obtained at power plant above station. Stage-discharge relation affected by ice Nov. 27, 1919, to Mar. 15, 1920: discharge ascertained by means of one discharge measurement, gage heights for part of period, observer's notes, weather records, and comparison with flow of this river at Marshalltown.

*Monthly discharge of Iowa River at Iowa City, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 3,140 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 640 | 208 | 330 | 0.105 | 0.12 |
| November | 980 | 580 | 701 | .223 | .25 |
| December | 1,900 | 550 | 898 | .286 | .33 |
| January | 1,190 | 420 | 789 | .251 | .29 |
| February | 1,980 | 400 | 1,170 | .373 | .39 |
| March | 9,000 | 262 | 4,000 | 1.27 | 1.46 |
| April | 7,510 | 2,340 | 4,760 | 1.52 | 1.70 |
| May | 12,800 | 1,620 | 5,000 | 1.59 | 1.83 |
| June | 6,940 | 1,780 | 4,890 | 1.56 | 1.74 |
| July | 2,430 | 600 | 1,280 | .408 | .47 |
| August | 1,200 | 275 | 554 | .176 | .20 |
| September | 1,550 | 79 | 454 | .145 | .16 |
| The year | 12,800 | 79 | 2,070 | .659 | 8.94 |
| 1919–20. | | | | | |
| October | 4,360 | 1,080 | 2,100 | .669 | .77 |
| November | 6,570 | 1,490 | 2,970 | .946 | 1.06 |
| December | 1,500 | 1,100 | 1,180 | .376 | .43 |
| January | 1,100 | 600 | 779 | .248 | .29 |
| February | 950 | 550 | 674 | .215 | .23 |
| March | 8,130 | 600 | 4,130 | 1.32 | 1.52 |
| April | 6,810 | 2,520 | 4,210 | 1.34 | 1.50 |
| May | 6,450 | 2,680 | 4,200 | 1.34 | 1.54 |
| June | 2,680 | 1,010 | 1,550 | .494 | .55 |
| July | 3,550 | 760 | 1,710 | .545 | .63 |
| August | 1,210 | 280 | 730 | .232 | .27 |
| September | 2,260 | 590 | 1,230 | .392 | .44 |
| The year | 8,130 | 280 | 2,130 | .678 | 9.23 |

### IOWA RIVER AT WAPELLO, IOWA.

LOCATION.—In sec. 27, T. 74 N., R. 3 W., at highway bridge half a mile from railroad station at Wapello, Louisa County, and 20 miles above mouth of river. No important tributaries enter near station.

DRAINAGE AREA.—At gaging station, 12,480 square miles; at mouth, 12,600 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—February 26, 1915, to September 30, 1920.

GAGE.—Chain gage attached to highway bridge near center of first span from right abutment; read by C. W. Warren.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifts slightly. Right bank high and not subject to overflow. Levee along left bank broke in June, 1918, causing flooding of considerable cultivated land.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 10.83 feet at 7 a. m. March 23 (discharge, 38,100 second-feet); minimum stage, −0.15 foot August 29 (discharge, 620 second-feet).

Maximum stage recorded during year ending September 30, 1920, 9.7 feet at 7 a. m. March 29 (discharge, 32,200 second-feet); minimum discharge, estimated 1,800 second-feet January 29–31 (stage-discharge relation affected by ice).

1915–1920: Maximum stage recorded, 14.94 feet June 8, 1918 (discharge, 63,100 second-feet); minimum discharge, about 400 second-feet December 15–17, 1916 (stage-discharge relation affected by ice).

The flood of June, 1892, was probably much higher than the flood of June, 1918.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation practically permanent during 1919 and to March 31, 1920, except as affected by ice; from April 1 to September 30, 1920, a gradual shift was taking place. One well defined rating curve used during 1919 and 1920; used direct October 1, 1918, to March 31, 1920, and as basic curve for shifting channel method April 1 to September 30, 1920. Gage read to hundredths once daily except during winter. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge and except for period during which indirect method for shifting channel was used. Open-water records excellent for 1919 and good for 1920; winter records fair.

*Discharge measurements of Iowa River at Wapello, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 26 | H. C. Beckman | 0.85 | 1,840 | Dec. 18[a] | C. Herlofson | 3.86 | 3,620 |
| 1919. | | | | 1920. | | | |
| Mar. 26 | Bolster and Reiner | 7.75 | 23,600 | Jan. 30[a] | do | 2.29 | 1,810 |
| Sept. 10 | C. Herlofson | .59 | 1,420 | Feb. 19[a] | do | 2.53 | 2,340 |
| 12 | Hoyt and Burchard | .43 | 1,320 | Aug. 7 | E. D. Burchard | 1.07 | 2,390 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Iowa River at Wapello, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 2,390 | 1,920 | | 2,000 | 5,200 | 1,660 | 11,700 | 15,700 | 6,200 | 8,790 | 2,560 | 1,050 |
| 2 | 2,390 | 1,920 | | 1,800 | 5,000 | 2,000 | 11,000 | 15,400 | 9,410 | 7,880 | 2,560 | 1,300 |
| 3 | 2,390 | | | 1,800 | 4,700 | 2,800 | 10,400 | 22,500 | 13,900 | 7,300 | 2,560 | 1,560 |
| 4 | 2,230 | | | 1,500 | 4,520 | 3,470 | 10,000 | 24,700 | 17,700 | 7,020 | 2,560 | 1,490 |
| 5 | 2,070 | | | 1,500 | 4,300 | 3,670 | 9,410 | 29,200 | 20,000 | 6,470 | 2,560 | 1,420 |
| 6 | 2,070 | | | 1,500 | 4,030 | 4,520 | 9,100 | 32,200 | 20,900 | 6,470 | 2,560 | 1,420 |
| 7 | 2,070 | | | 1,500 | 3,000 | 5,440 | 9,100 | 34,700 | 21,300 | 6,200 | 2,730 | 1,360 |
| 8 | 2,070 | | 4,100 | 1,600 | 1,800 | 5,940 | 9,100 | 34,200 | 21,300 | 5,690 | 2,910 | 1,230 |
| 9 | 2,070 | | | 1,800 | 2,000 | 6,200 | 9,100 | 34,700 | 20,500 | 5,690 | 3,090 | 1,360 |
| 10 | 2,000 | | | 2,000 | 2,500 | 6,470 | 11,000 | 31,700 | 19,600 | 5,440 | 3,090 | 1,360 |
| 11 | 2,000 | | | 2,000 | 3,000 | 8,180 | 12,800 | 26,000 | 18,400 | 5,200 | 3,090 | 1,360 |
| 12 | 1,920 | | | 2,000 | 4,520 | 8,790 | 15,000 | 23,800 | 15,700 | 4,970 | 3,470 | 1,300 |
| 13 | 1,920 | | | 2,500 | 4,740 | 9,730 | 16,900 | 21,700 | 15,400 | 4,970 | 3,470 | 1,360 |
| 14 | 2,000 | | | 2,500 | 5,200 | 11,400 | 19,200 | 18,000 | 16,900 | 4,740 | 3,470 | 1,360 |
| 15 | 1,920 | | | 2,500 | 7,300 | 12,100 | 22,100 | 16,100 | 16,100 | 4,740 | 3,880 | 1,360 |
| 16 | 1,920 | 4,600 | 5,440 | 2,500 | 6,470 | 25,600 | 25,600 | 14,600 | 17,300 | 4,520 | 3,670 | 1,360 |
| 17 | 1,840 | | 5,690 | 2,800 | 5,940 | 32,700 | 28,800 | 12,800 | 18,400 | 4,300 | 2,910 | 1,360 |
| 18 | 1,770 | | 5,690 | 2,800 | 6,200 | 36,300 | 31,700 | 11,700 | 18,800 | 4,300 | 2,730 | 1,490 |
| 19 | 1,770 | | 5,690 | 2,800 | 6,740 | 34,700 | 31,200 | 11,000 | 17,700 | 4,300 | 2,560 | 1,630 |
| 20 | 1,770 | | 5,440 | 3,000 | 6,740 | 31,700 | 27,800 | 10,400 | 16,500 | 4,520 | 2,390 | 2,070 |
| 21 | 1,770 | | 5,440 | 3,000 | 7,020 | 30,200 | 26,900 | 9,730 | 16,500 | 4,300 | 2,390 | 2,730 |
| 22 | 1,840 | | 5,200 | 3,000 | 7,300 | 35,200 | 27,400 | 9,730 | 16,500 | 4,090 | 2,230 | 3,090 |
| 23 | 1,840 | | 5,200 | 3,500 | 7,300 | 37,400 | 28,300 | 9,100 | 16,500 | 3,670 | 2,000 | 3,280 |
| 24 | 1,920 | | 4,970 | 4,000 | 7,300 | 33,700 | 27,800 | 9,100 | 16,500 | 3,670 | 2,000 | 3,280 |
| 25 | 1,920 | | 4,830 | 4,500 | 6,200 | 27,800 | 26,900 | 8,790 | 18,800 | 3,470 | 1,840 | 2,910 |
| 26 | 1,840 | | 4,500 | 5,000 | 5,940 | 21,700 | 27,400 | 8,180 | 21,300 | 3,280 | 1,490 | 2,390 |
| 27 | 1,840 | | 2,830 | 5,000 | 5,000 | 18,400 | 23,400 | 7,880 | 20,000 | 2,910 | 880 | 2,070 |
| 28 | 1,840 | | 2,500 | 5,440 | 3,300 | 15,400 | 20,900 | 7,300 | 17,700 | 2,910 | 720 | 2,070 |
| 29 | 1,920 | | 2,300 | 5,300 | ..... | 13,900 | 19,600 | 7,020 | 12,400 | 2,730 | 620 | 1,920 |
| 30 | 1,920 | | 2,200 | 5,300 | ..... | 13,200 | 17,300 | 6,740 | 9,730 | 2,730 | 880 | 4,740 |
| 31 | 1,920 | ..... | 2,100 | 5,300 | ..... | 12,400 | ..... | 6,470 | ..... | 2,730 | 825 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 7,300 | 11,000 | 4,500 | 2,700 | 1,900 | 2,500 | 24,700 | 17,300 | 9,260 | 4,740 | 3,000 | 3,090 |
| 2 | 7,880 | 7,020 | 3,000 | 2,600 | 1,900 | 3,000 | 26,000 | 16,100 | 8,640 | 4,740 | 2,820 | 2,910 |
| 3 | 8,480 | 6,740 | 2,700 | 2,500 | 1,900 | 3,500 | 28,300 | 15,400 | 8,330 | 4,970 | 2,820 | 2,730 |
| 4 | 9,100 | 5,940 | 2,900 | 2,400 | 1,900 | 4,000 | 27,400 | 14,200 | 9,570 | 4,740 | 2,820 | 2,910 |
| 5 | 10,000 | 5,440 | 3,000 | 2,400 | 1,900 | 4,400 | 23,400 | 13,200 | 9,260 | 4,520 | 2,640 | 2,910 |
| 6 | 10,700 | 4,520 | 3,200 | 2,200 | 1,900 | 4,200 | 20,500 | 12,400 | 7,740 | 4,300 | 2,480 | 3,090 |
| 7 | 10,400 | 4,300 | 3,400 | 2,200 | 2,000 | 3,900 | 16,500 | 11,700 | 7,160 | 4,300 | 2,310 | 3,090 |
| 8 | 12,100 | 4,740 | 3,600 | 2,100 | 2,100 | 3,700 | 14,200 | 10,700 | 6,600 | 4,300 | 2,310 | 3,090 |
| 9 | 11,400 | 9,410 | 3,800 | 2,100 | 2,200 | 4,000 | 12,400 | 10,400 | 6,070 | 5,200 | 2,310 | 3,470 |
| 10 | 10,700 | 13,500 | 4,000 | 2,100 | 2,300 | 4,500 | 11,400 | 10,000 | 5,820 | 6,740 | 2,310 | 3,670 |
| 11 | 9,410 | 18,800 | 4,000 | 2,100 | 2,400 | 5,500 | 11,000 | 9,730 | 5,560 | 6,470 | 2,480 | 3,470 |
| 12 | 6,200 | 21,300 | 3,900 | 2,100 | 2,500 | 10,000 | 10,700 | 12,800 | 5,560 | 6,200 | 2,640 | 3,090 |
| 13 | 5,690 | 23,400 | 3,900 | 2,100 | 2,600 | 13,000 | 10,000 | 18,000 | 5,320 | 6,200 | 2,640 | 3,470 |
| 14 | 4,970 | 22,100 | 3,800 | 2,100 | 2,700 | 15,000 | 9,410 | 20,000 | 5,080 | 6,470 | 3,000 | 3,670 |
| 15 | 4,740 | 18,800 | 3,700 | 2,100 | 2,600 | 16,500 | 9,410 | 20,900 | 4,630 | 6,200 | 2,640 | 3,470 |
| 16 | 4,520 | 16,900 | 3,700 | 2,100 | 2,600 | 16,900 | 9,410 | 20,500 | 4,630 | 5,690 | 2,480 | 3,470 |
| 17 | 4,300 | 13,900 | 3,600 | 2,100 | 2,500 | 19,200 | 9,410 | 19,200 | 4,420 | 5,440 | 2,480 | 3,880 |
| 18 | 4,090 | 11,000 | 3,600 | 2,100 | 2,500 | 20,900 | 10,000 | 18,000 | 4,190 | 6,470 | 2,310 | 4,300 |
| 19 | 3,880 | 10,000 | 3,600 | 2,000 | 2,300 | 19,200 | 11,700 | 16,500 | 4,190 | 6,470 | 2,230 | 5,200 |
| 20 | 3,880 | 8,790 | 3,600 | 2,000 | 2,300 | 18,000 | 21,300 | 14,600 | 4,420 | 6,200 | 2,070 | 4,740 |
| 21 | 3,670 | 8,180 | 3,400 | 1,900 | 2,200 | 16,500 | 22,500 | 13,200 | 4,190 | 5,690 | 2,070 | 4,520 |
| 22 | 3,470 | 7,590 | 3,200 | 1,900 | 2,200 | 15,400 | 21,300 | 12,800 | 4,630 | 5,440 | 2,070 | 3,880 |
| 23 | 3,470 | 7,300 | 3,100 | 1,900 | 2,100 | 13,500 | 23,000 | 12,100 | 4,420 | 4,970 | 2,070 | 3,670 |
| 24 | 3,280 | 7,300 | 3,000 | 1,900 | 2,100 | 15,000 | 21,700 | 13,200 | 4,420 | 4,520 | 2,150 | 3,280 |
| 25 | 3,090 | 7,020 | 2,900 | 1,900 | 2,000 | 22,100 | 18,900 | 16,100 | 4,420 | 4,300 | 5,320 | 3,090 |
| 26 | 3,470 | 7,020 | 2,900 | 1,900 | 2,000 | 26,500 | 16,100 | 15,700 | 4,420 | 4,090 | 5,080 | 3,090 |
| 27 | 3,880 | 6,470 | 2,800 | 1,900 | 2,000 | 28,800 | 15,400 | 14,200 | 4,190 | 3,880 | 4,410 | 3,090 |
| 28 | 4,740 | 6,200 | 2,800 | 1,900 | 2,000 | 31,700 | 15,400 | 13,900 | 4,190 | 3,670 | 3,570 | 2,910 |
| 29 | 6,470 | 5,940 | 2,800 | 1,800 | 2,100 | 32,200 | 16,100 | 12,400 | 3,980 | 3,090 | 3,570 | 2,730 |
| 30 | 7,590 | 5,500 | 2,800 | 1,800 | ..... | 29,200 | 16,100 | 11,000 | 4,860 | 2,910 | 3,380 | 2,730 |
| 31 | 9,410 | ..... | 2,700 | 1,800 | ..... | 25,600 | ..... | 10,400 | ..... | 2,910 | 3,180 | ..... |

NOTE.—Stage-discharge relation affected by ice, Dec. 25, 1918, to Jan. 27, 1919, Feb. 7-11, Feb. 27 to Mar. 3, 1919, and Nov. 30, 1919, to Mar. 14, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. No gage-height record obtained, Nov. 3 to Dec. 15, 1918; discharge ascertained by combining flow of Cedar River at Cedar Rapids with flow of Iowa River at Iowa City. Bracketed figures show mean discharge for periods indicated.

*Monthly discharge of Iowa River at Wapello, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 12,500 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,390 | 1,770 | 1,970 | 0.158 | 0.18 |
| November | | | 4,420 | .354 | .40 |
| December | | | 4,240 | .340 | .39 |
| January | 5,440 | 1,500 | 2,960 | .237 | .27 |
| February | 7,300 | 1,800 | 5,120 | .410 | .43 |
| March | 37,400 | 1,600 | 16,500 | 1.32 | 1.52 |
| April | 31,700 | 9,100 | 19,200 | 1.54 | 1.72 |
| May | 34,700 | 6,470 | 17,100 | 1.37 | 1.58 |
| June | 21,300 | 6,200 | 16,900 | 1.35 | 1.51 |
| July | 8,790 | 2,730 | 4,840 | .388 | .45 |
| August | 3,880 | 620 | 2,410 | .193 | .22 |
| September | 4,740 | 1,050 | 1,890 | .151 | .17 |
| The year | 37,400 | 620 | 8,140 | .652 | 8.84 |
| 1919–20. | | | | | |
| October | 12,100 | 3,090 | 6,530 | .523 | .60 |
| November | 23,400 | 4,300 | 10,200 | .817 | .91 |
| December | 4,500 | 2,700 | 3,350 | .268 | .31 |
| January | 2,700 | 1,800 | 2,090 | .167 | .19 |
| February | 2,700 | 1,900 | 2,200 | .176 | .19 |
| March | 32,200 | 2,500 | 14,500 | 1.16 | 1.34 |
| April | 28,300 | 9,410 | 16,800 | 1.35 | 1.51 |
| May | 20,900 | 9,730 | 14,400 | 1.15 | 1.33 |
| June | 9,570 | 3,980 | 5,670 | .454 | .51 |
| July | 6,740 | 2,910 | 5,030 | .403 | .46 |
| August | 5,320 | 2,070 | 2,830 | .227 | .26 |
| September | 5,200 | 2,730 | 3,420 | .274 | .31 |
| The year | 32,200 | 1,800 | 7,260 | .582 | 7.92 |

### CEDAR RIVER AT JANESVILLE, IOWA.

LOCATION.—In sec. 35, T. 91 N., R. 14 W., at highway bridge in Janesville, Bremer County, a quarter of a mile above old gaging station and 3 miles above junction with Shellrock River.

DRAINAGE AREA.—1,660 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 27, 1905, to September 30, 1906; May 26, 1915, to September 30, 1920.

GAGE.—Chain gage attached to downstream handrail of center span of highway bridge, installed July 26, 1919. Prior to that date a chain gage attached to Illinois Central Railroad bridge, a quarter of a mile downstream, was used. Gage read by Mrs. Lydia Matz and Miss Lizzie Ulrich.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Ruins of an old grist mill dam forms control; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 8.6 feet April 11 and 12 (discharge, 6,700 second-feet); minimum stage, 1.72 feet at 7.40 a. m. September 2 (discharge, 161 second-feet).

Maximum stage recorded during year ending September 30, 1920, 7.27 feet at 5.40 p. m. March 28 (discharge, about 7,560 second-feet); minimum stage, 1.60 feet, July 23 to 27 (discharge, about 118 second-feet).

1905–6 and 1915–1920: Maximum discharge recorded, 22,600 second-feet March 28, 1906; minimum discharge recorded, 100 second-feet November 3, 1915.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

REGULATION.—Slight diurnal fluctuation at low stages is caused by operation of power plant at Waverly, 9 miles above station.

ACCURACY.—Stage-discharge relation practically permanent for both locations of gage. Rating curve for old gage location, used March 26 to July 21, 1919, is fairly well defined; curve for new gage location, used after July 21, 1919, is well defined between 200 and 2,000 second-feet; extended beyond these limits and may be in error. Gage read to hundredths once daily except during winter and periods noted in footnote to tables of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records good for low and medium stages during 1920; fair for 1919 and for high stages in 1920.

*Discharge measurements of Cedar River at Janesville, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 13 | H. C. Beckman | 1.50 | 244 | Sept. 9 | E. D. Burchard | 1.83 | 219 |
| 1919. | | | | 1920. | | | |
| Mar. 25 | R. H. Bolster | 3.86 | 1,690 | Apr. 16 | do | 2.76 | 931 |
| May 15 | E. D. Burchard | 2.96 | 984 | May 27 | do | 3.16 | 1,330 |
| July 26 | do | 2.18 | 429 | Aug. 30 | do | 1.91 | 269 |
| Aug. 8 | do | 2.01 | 334 | | | | |

NOTE.—Measurement made July 26, 1919, and subsequent measurements are referred to new gage at highway bridge; measurements made prior to July 26, 1919, are referred to old gage at railroad bridge.

*Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | | | | |
| 1 | | | | 1,320 | 1,090 | 545 | 580 | 360 | 216 |
| 2 | | | | 1,090 | 1,020 | 1,160 | 545 | 340 | 161 |
| 3 | | | | 1,090 | 1,020 | 1,090 | 545 | 400 | 227 |
| 4 | | | | 1,090 | 1,160 | 1,480 | 478 | 480 | 238 |
| 5 | | | | 1,020 | 1,020 | 1,630 | 254 | 480 | 227 |
| 6 | | | | 1,020 | 1,160 | 1,400 | 545 | 420 | 216 |
| 7 | | | | 1,160 | 1,400 | 1,240 | 380 | 360 | 368 |
| 8 | | | | 2,020 | 2,160 | 1,240 | 400 | 344 | 227 |
| 9 | | | | 4,170 | 2,020 | 1,160 | 380 | 356 | 216 |
| 10 | | | | 6,540 | 1,820 | 2,650 | 432 | 344 | 232 |
| 11 | | | | 6,700 | 1,560 | 3,720 | 406 | 344 | 344 |
| 12 | | | | 6,700 | 1,020 | 3,310 | 356 | 344 | 254 |
| 13 | | | | 6,540 | 1,090 | 2,920 | 406 | 374 | 249 |
| 14 | | | | 4,170 | 1,020 | 2,400 | 368 | 374 | 290 |
| 15 | | | | 4,280 | 1,020 | 2,160 | 1,320 | 393 | 290 |
| 16 | | | | 3,840 | 902 | 2,020 | 1,400 | 374 | 210 |
| 17 | | | | 4,880 | 865 | 1,750 | 1,090 | 314 | 320 |
| 18 | | | | 4,880 | 865 | 1,690 | 790 | 314 | 332 |
| 19 | | | | 4,640 | 720 | 1,630 | 545 | 368 | 412 |
| 20 | | | | 4,280 | 790 | 1,480 | 510 | 374 | 438 |
| 21 | | | | 3,620 | 650 | 2,320 | 400 | 510 | 406 |
| 22 | | | | 2,560 | 650 | 1,160 | 380 | 356 | 326 |
| 23 | | | | 2,160 | 615 | 1,160 | 380 | 344 | 266 |
| 24 | | | | 1,950 | 545 | 1,020 | 380 | 374 | 326 |
| 25 | | | | 1,560 | 478 | 510 | 400 | 320 | 368 |
| 26 | | | 1,690 | 1,400 | 290 | 755 | 432 | 272 | 374 |
| 27 | | | 1,690 | 1,320 | 380 | 755 | 440 | 216 | 350 |
| 28 | | | 1,750 | 1,160 | 510 | 650 | 420 | 296 | 350 |
| 29 | | | 1,750 | 1,160 | 400 | 615 | 400 | 296 | 254 |
| 30 | | | 1,480 | 1,160 | 374 | 650 | 380 | 296 | 432 |
| 31 | | | 1,400 | | 254 | | 360 | 249 | |
| 1919–20. | | | | | | | | | |
| 1 | 505 | 428 | | 2,080 | 1,480 | 660 | 542 | 402 | 282 |
| 2 | 364 | 310 | | 2,460 | 1,360 | 542 | 705 | 299 | 310 |
| 3 | 340 | 358 | | 1,950 | 1,040 | 542 | 580 | 470 | 505 |
| 4 | 346 | 266 | | 1,710 | 995 | 435 | 542 | 470 | 505 |
| 5 | 334 | 352 | | 1,480 | 895 | 435 | 620 | 422 | 505 |
| 6 | 422 | 310 | | 1,260 | 750 | 435 | 620 | 282 | 505 |
| 7 | 383 | 340 | | 1,260 | 798 | 470 | 1,150 | 265 | 402 |
| 8 | 340 | 299 | | 1,150 | 705 | 542 | 1,100 | 245 | 396 |
| 9 | 383 | 396 | | 1,040 | 660 | 542 | 845 | 230 | 396 |
| 10 | 322 | 542 | | 995 | 505 | 435 | 1,100 | 255 | 1,100 |
| 11 | 364 | 1,360 | | 995 | 620 | 402 | 1,150 | 255 | 995 |
| 12 | 304 | 1,040 | | 895 | 945 | 402 | 945 | 250 | 580 |
| 13 | 304 | 945 | | 845 | 945 | 310 | 798 | 240 | 580 |
| 14 | 245 | 1,040 | | 895 | 895 | 402 | 705 | 230 | 505 |
| 15 | 255 | 945 | | 895 | 820 | 402 | 798 | 230 | 1,040 |
| 16 | 310 | 705 | | 895 | 750 | 705 | 705 | 230 | 470 |
| 17 | 304 | 995 | | 705 | 505 | 505 | 620 | 225 | 470 |
| 18 | 322 | 995 | | 705 | 750 | 750 | 542 | 225 | 470 |
| 19 | 346 | 620 | | 800 | 660 | 845 | 390 | 255 | 470 |
| 20 | 322 | 505 | 3,580 | 1,600 | 798 | 895 | 340 | 266 | 470 |
| 21 | 316 | 542 | 2,600 | 1,360 | 750 | 845 | 310 | 376 | 470 |
| 22 | 322 | 505 | 2,600 | 1,950 | 750 | 845 | 205 | 299 | 505 |
| 23 | 288 | 542 | 2,600 | 1,950 | 1,950 | 845 | 118 | 266 | 470 |
| 24 | 277 | 470 | 2,870 | 1,600 | 2,870 | 750 | 118 | 299 | 470 |
| 25 | 255 | 435 | 2,600 | 1,360 | 1,830 | 705 | 118 | 299 | 470 |
| 26 | 304 | 435 | 4,680 | 1,150 | 1,710 | 505 | 118 | 299 | 390 |
| 27 | 299 | 370 | 6,860 | 1,710 | 1,150 | 340 | 118 | 310 | 383 |
| 28 | 255 | 435 | 7,420 | 1,360 | 1,040 | 310 | 196 | 316 | 435 |
| 29 | 346 | 440 | 6,320 | 1,360 | 995 | 316 | 205 | 316 | 310 |
| 30 | 358 | 480 | 3,440 | 1,480 | 845 | 402 | 282 | 299 | 310 |
| 31 | 383 | | 2,330 | | 845 | | 299 | 294 | |

NOTE.—Observations discontinued Oct. 1, 1918, to Mar. 25, 1919, and Dec. 1, 1919, to Mar. 19, 1920; discharge not determined. Discharge estimated because of ice Nov. 26–30, 1919. Gage not read July 22–25, and July 27 to Aug. 7, 1919, Apr. 19, May 15, Aug. 7 and 8, 1920; discharge ascertained by comparison with flow of Cedar River at Cedar Rapids and Shellrock River near Clarksville. Gage readings began at new location Aug. 8, 1919.

*Monthly discharge of Cedar River at Janesville, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,660 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1919. | | | | | |
| April | 6,700 | 1,020 | 2,980 | 1.80 | 2.01 |
| May | 2,160 | 254 | 931 | .561 | .65 |
| June | 3,720 | 510 | 1,540 | .928 | 1.04 |
| July | 1,400 | 254 | 519 | .313 | .36 |
| August | 510 | 216 | 354 | .213 | .25 |
| September | 438 | 161 | 297 | .179 | .20 |
| 1919–20. | | | | | |
| October | 505 | 245 | 330 | .199 | .23 |
| November | 1,360 | 266 | 580 | .349 | .39 |
| March 20–31 | 7,420 | 2,330 | 3,990 | 2.40 | 1.07 |
| April | 2,460 | 705 | 1,330 | .801 | .89 |
| May | 2,870 | 505 | 1,020 | .614 | .71 |
| June | 895 | 310 | 551 | .332 | .37 |
| July | 1,150 | 118 | 545 | .328 | .38 |
| August | 470 | 225 | 294 | .177 | .20 |
| September | 1,100 | 282 | 506 | .305 | .34 |

### CEDAR RIVER AT CEDAR RAPIDS, IOWA.

LOCATION.—In sec. 28, T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, half a mile below dam and 1,000 feet above Eighth Avenue bridge.

DRAINAGE AREA.—At gaging station, 6,640 square miles; at junction with Iowa River, 7,930 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—February 14, 1903, to September 30, 1920.

GAGE.—Gurley water-stage recorder on right bank, in rear of plant of Iowa Windmill & Pump Co.; installed August 20, 1920. Prior to that date an inclined staff gage at same location and same datum was used. Elevation of zero of both gages from Northwestern Railroad levels, 723.03 feet above sea level. Observer, R. S. Toogood.

DISCHARGE MEASUREMENTS.—Made usually from upstream side of Eighth Avenue bridge.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; free from vegetation; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 11.4 feet March 20 (discharge, 29,700 second-feet); minimum stage, 2.9 feet September 16 and 17 (discharge, 775 second-feet).

Maximum stage recorded during year ending September 30, 1920, 7.5 feet March 30 (discharge, 14,400 second-feet); minimum discharge, estimated 550 second-feet February 4 and 7 (stage-discharge relation affected by ice).

1902–1920: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,100 second-feet); minimum discharge probably somewhat less than 400 second-feet during latter part of December, 1916 (stage-discharge relation affected by ice).

Greatest known flood probably occurred in June, 1851, when the maximum stage was about 20 feet (discharge, about 65,000 second-feet).

ICE.—Stage-discharge relation affected by ice during extremely cold weather. The swift current and the proximity of the power plant keeps measuring section open during mild winters.

REGULATION.—Since 1917, operation of power plant half a mile above gage has caused marked diurnal fluctuation during periods of low water. There is no dam below gage which might cause backwater.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined above 1,000 second-feet. Gage read to tenths once daily prior to August 20, 1920; since that date a continuous record has been obtained from the water-stage recorder. Daily discharge prior to August 20, 1920, ascertained by applying daily gage height to rating table, except for period, November 28, 1919, to March 16, 1920, during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records; subsequent to August 20, 1920, daily discharge was ascertained by use of discharge integrator. Records excellent except for periods of low water prior to installation of water-stage recorder, and except for period of ice effect, for which they are fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Cedar River at Cedar Rapids, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 12 | H. C. Beckman | 3.26 | 1,310 | Jan. 6[a] | E. D. Burchard | 3.38 | 883 |
| | | | | 31[a] | C. Herlofson | 3.40 | 861 |
| 1919. | | | | Feb. 20[a] | do | 3.33 | 942 |
| Mar. 21 | R. H. Bolster | 9.38 | 22,100 | Mar. 3[a] | E. D. Burchard | 3.66 | 1,510 |
| May 11 | E. D. Burchard | 5.84 | 8,840 | Apr. 13 | do | 4.51 | 4,340 |
| June 8 | do | 5.62 | 7,580 | Aug. 5 | do | 3.38 | 1,469 |
| July 22 | do | 3.74 | 2,230 | | | | |
| Dec. 19[a] | C. Herlofson | 3.79 | 1,270 | | | | |

[a] Measurement made partly through ice.

*Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 1,460 | 4,590 | 2,800 | 2,200 | 2,920 | 2,920 | 6,410 | 6,730 | 2,920 | 4,300 | 1,760 | 1,370 |
| 2 | 1,460 | 5,180 | 3,050 | 1,970 | 2,920 | 1,970 | 7,050 | 7,050 | 4,300 | 3,450 | 1,560 | 1,370 |
| 3 | 1,460 | 4,590 | 2,550 | 2,200 | 2,920 | 1,560 | 5,790 | 8,340 | 4,300 | 3,180 | 1,760 | 1,370 |
| 4 | 1,460 | 4,590 | 2,320 | 2,200 | 3,180 | 1,370 | 5,480 | 11,100 | 6,730 | 3,180 | 1,970 | 1,370 |
| 5 | 1,460 | 3,870 | 2,550 | 2,430 | 2,920 | 2,920 | 4,590 | 11,400 | 6,730 | 3,460 | 2,670 | 1,370 |
| 6 | 1,460 | 3,590 | 2,550 | 1,970 | 1,560 | 2,430 | 4,880 | 8,010 | 7,370 | 3,180 | 1,970 | 1,200 |
| 7 | 1,280 | 3,320 | 2,550 | 1,970 | 1,560 | 2,430 | 4,590 | 12,500 | 8,010 | 3,180 | 1,970 | 1,040 |
| 8 | 1,280 | 3,050 | 2,550 | 1,970 | 1,760 | 2,920 | 5,180 | 10,000 | 8,010 | 2,920 | 1,760 | 1,040 |
| 9 | 1,280 | 2,800 | 2,550 | 1,760 | 1,970 | 3,180 | 5,790 | 8,010 | 8,010 | 2,920 | 1,560 | 905 |
| 10 | 1,120 | 2,800 | 2,550 | 1,970 | 2,200 | 3,450 | 8,340 | 8,340 | 8,010 | 2,920 | 1,560 | 905 |
| 11 | 1,280 | 2,800 | 2,550 | 2,200 | 2,200 | 3,450 | 10,700 | 8,010 | 7,370 | 2,670 | 1,560 | 905 |
| 12 | 1,280 | 2,800 | 2,800 | 2,670 | 2,200 | 4,880 | 12,500 | 8,010 | 7,690 | 2,670 | 1,560 | 905 |
| 13 | 1,280 | 2,550 | 3,870 | 2,430 | 2,430 | 6,410 | 15,900 | 7,370 | 8,670 | 2,430 | 1,760 | 905 |
| 14 | 1,280 | 2,550 | 4,590 | 2,430 | 2,670 | 4,880 | 19,500 | 8,010 | 11,400 | 2,430 | 1,970 | 905 |
| 15 | 1,280 | 2,550 | 4,590 | 2,200 | 3,180 | 6,100 | 21,800 | 6,730 | 13,300 | 2,200 | 1,970 | 905 |
| 16 | 1,120 | 2,550 | 4,590 | 2,430 | 2,920 | 11,800 | 21,000 | 5,180 | 11,400 | 2,430 | 1,760 | 775 |
| 17 | 1,120 | 2,550 | 4,590 | 2,430 | 2,920 | 11,800 | 17,900 | 4,880 | 10,700 | 2,430 | 1,760 | 775 |
| 18 | 1,280 | 2,320 | 4,590 | 2,430 | 5,480 | 12,500 | 16,300 | 4,880 | 9,340 | 2,200 | 1,560 | 905 |
| 19 | 1,120 | 2,550 | 4,590 | 2,200 | 5,790 | 23,800 | 16,700 | 4,590 | 9,000 | 2,920 | 1,560 | 1,560 |
| 20 | 1,120 | 3,050 | 4,590 | 2,200 | 5,790 | 29,700 | 17,500 | 4,300 | 9,000 | 2,430 | 1,560 | 1,560 |
| 21 | 1,280 | 3,870 | 4,010 | 2,200 | 4,590 | 23,800 | 17,100 | 4,010 | 9,000 | 2,430 | 1,560 | 1,760 |
| 22 | 1,280 | 4,590 | 3,870 | 2,430 | 5,180 | 17,100 | 14,800 | 3,730 | 9,680 | 2,200 | 1,560 | 2,670 |
| 23 | 1,280 | 4,590 | 3,870 | 2,200 | 5,180 | 13,300 | 15,500 | 3,730 | 10,400 | 2,200 | 1,560 | 1,560 |
| 24 | 1,280 | 4,010 | 3,590 | 2,200 | 5,180 | 10,400 | 13,600 | 3,730 | 9,000 | 2,200 | 1,560 | 1,040 |
| 25 | 1,280 | 4,010 | 3,320 | 2,200 | 4,590 | 8,670 | 10,000 | 3,730 | 8,010 | 2,200 | 1,560 | 1,370 |
| 26 | 1,120 | 3,590 | 2,800 | 2,670 | 4,010 | 8,010 | 9,340 | 3,450 | 7,690 | 1,970 | 1,370 | 1,200 |
| 27 | 1,280 | 3,050 | 2,550 | 2,920 | 3,450 | 7,370 | 8,340 | 3,450 | 7,690 | 1,970 | 1,370 | 1,370 |
| 28 | 1,460 | 3,050 | 2,320 | 4,010 | 3,450 | 7,050 | 7,690 | 3,180 | 7,370 | 1,970 | 1,370 | 1,370 |
| 29 | 1,460 | 4,010 | 1,860 | 4,010 | ..... | 7,050 | 7,050 | 3,180 | 6,100 | 2,200 | 1,370 | 1,370 |
| 30 | 1,860 | 3,050 | 1,860 | 2,920 | ..... | 7,050 | 6,410 | 3,180 | 4,590 | 1,970 | 1,370 | 1,370 |
| 31 | 3,870 | ..... | 2,080 | 2,920 | ..... | 6,730 | ..... | 2,920 | ..... | 1,970 | 1,370 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 1,560 | 2,430 | 2,600 | 1,600 | 1,300 | 900 | 11,800 | 6,730 | 4,300 | 2,670 | 1,560 | 1,860 |
| 2 | 1,370 | 2,430 | 2,600 | 1,500 | 700 | 650 | 11,100 | 6,410 | 4,590 | 2,670 | 1,560 | 1,970 |
| 3 | 1,370 | 2,430 | 1,800 | 1,300 | 600 | 800 | 10,700 | 6,100 | 5,790 | 2,670 | 1,370 | 1,970 |
| 4 | 2,920 | 2,430 | 1,800 | 1,300 | 550 | 3,000 | 9,000 | 5,790 | 4,590 | 2,430 | 1,200 | 1,970 |
| 5 | 7,050 | 2,200 | 1,800 | 1,300 | 650 | 5,000 | 8,670 | 5,480 | 4,300 | 2,670 | 1,040 | 2,430 |
| 6 | 8,010 | 2,200 | 1,900 | 1,200 | 650 | 3,000 | 7,370 | 5,180 | 4,010 | 3,180 | 1,560 | 2,430 |
| 7 | 8,010 | 2,200 | 2,000 | 1,600 | 550 | 4,800 | 6,410 | 4,590 | 3,730 | 2,920 | 3,180 | 2,550 |
| 8 | 8,010 | 2,200 | 1,800 | 2,000 | 650 | 2,600 | 5,790 | 4,300 | 3,730 | 2,920 | 3,450 | 2,670 |
| 9 | 7,690 | 2,920 | 1,700 | 900 | 1,300 | 2,000 | 5,480 | 4,010 | 3,450 | 4,010 | 3,180 | 2,670 |
| 10 | 4,590 | 7,690 | 1,900 | 800 | 700 | 1,800 | 5,180 | 3,730 | 3,180 | 4,590 | 1,970 | 2,550 |
| 11 | 4,010 | 9,680 | 1,500 | 900 | 1,300 | 2,000 | 4,880 | 3,730 | 3,180 | 4,880 | 1,560 | 2,550 |
| 12 | 3,180 | 8,010 | 1,500 | 900 | 1,400 | 3,600 | 4,590 | 4,010 | 2,920 | 4,590 | 1,370 | 2,920 |
| 13 | 2,670 | 7,370 | 1,300 | 1,800 | 1,200 | 4,800 | 4,590 | 8,340 | 2,670 | 4,300 | 1,560 | 4,300 |
| 14 | 2,430 | 6,730 | 2,400 | 1,200 | 900 | 3,800 | 4,300 | 8,010 | 2,670 | 4,010 | 1,370 | 5,480 |
| 15 | 2,430 | 5,480 | 2,600 | 1,400 | 1,000 | 4,000 | 4,300 | 7,050 | 2,670 | 4,010 | 1,370 | 4,590 |
| 16 | 2,430 | 4,590 | 2,000 | 1,400 | 850 | 9,000 | 4,590 | 7,050 | 2,670 | 4,010 | 1,370 | 4,010 |
| 17 | 2,200 | 4,300 | 2,000 | 1,800 | 700 | 8,340 | 4,590 | 7,370 | 2,430 | 4,010 | 1,370 | 3,590 |
| 18 | 2,200 | 4,010 | 1,500 | 1,600 | 800 | 7,690 | 4,300 | 6,410 | 2,670 | 3,730 | 1,200 | 3,320 |
| 19 | 2,200 | 4,010 | 1,900 | 900 | 1,800 | 7,050 | 4,880 | 6,100 | 2,670 | 3,730 | 1,560 | 2,920 |
| 20 | 2,200 | 3,730 | 1,900 | 900 | 800 | 6,730 | 7,690 | 5,480 | 2,920 | 3,450 | 1,370 | 2,550 |
| 21 | 2,200 | 3,730 | 1,700 | 700 | 800 | 8,670 | 10,400 | 5,480 | 3,450 | 3,450 | 2,920 | 2,430 |
| 22 | 1,760 | 3,450 | 1,700 | 850 | 800 | 8,340 | 8,010 | 5,480 | 3,180 | 3,450 | 4,590 | 2,200 |
| 23 | 1,760 | 3,450 | 1,300 | 700 | 650 | 8,010 | 7,690 | 12,200 | 3,180 | 3,180 | 4,880 | 2,080 |
| 24 | 1,560 | 3,450 | 1,300 | 850 | 650 | 7,690 | 7,370 | 8,010 | 3,180 | 2,670 | 4,300 | 2,080 |
| 25 | 1,560 | 3,180 | 1,100 | 850 | 800 | 9,340 | 7,690 | 7,050 | 2,920 | 2,430 | 3,730 | 2,080 |
| 26 | 1,560 | 3,180 | 1,100 | 850 | 900 | 12,500 | 9,000 | 8,670 | 2,920 | 2,430 | 3,050 | 2,200 |
| 27 | 1,560 | 3,180 | 1,100 | 700 | 800 | 11,800 | 8,010 | 8,010 | 2,670 | 2,200 | 2,800 | 2,200 |
| 28 | 1,560 | 3,000 | 1,100 | 700 | 650 | 11,100 | 7,370 | 7,050 | 2,670 | 1,970 | 2,430 | 2,200 |
| 29 | 1,560 | 2,800 | 1,400 | 700 | 650 | 10,000 | 7,050 | 6,730 | 2,920 | 1,760 | 2,200 | 2,080 |
| 30 | 1,370 | 3,000 | 1,400 | 600 | ..... | 14,400 | 6,730 | 5,790 | 2,920 | 1,560 | 2,080 | 1,970 |
| 31 | 1,970 | ..... | 1,200 | 1,700 | ..... | 13,600 | ..... | 4,880 | ..... | 1,560 | 1,970 | ..... |

*Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 6,640 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 3,870 | 1,120 | 1,400 | 0.211 | 0.24 |
| November | 5,180 | 2,320 | 3,420 | .515 | .57 |
| December | 4,590 | 1,860 | 3,210 | .483 | .56 |
| January | 4,010 | 1,760 | 2,420 | .364 | .42 |
| February | 5,790 | 1,560 | 3,400 | .512 | .53 |
| March | 29,700 | 1,370 | 8,290 | 1.25 | 1.44 |
| April | 21,800 | 4,590 | 11,300 | 1.70 | 1.90 |
| May | 12,500 | 2,920 | 6,180 | .931 | 1.07 |
| June | 13,300 | 2,920 | 8,060 | 1.21 | 1.35 |
| July | 4,300 | 1,970 | 2,610 | .393 | .45 |
| August | 2,670 | 1,370 | 1,660 | .250 | .29 |
| September | 2,670 | 775 | 1,240 | .187 | .21 |
| The year | 29,700 | 775 | 4,420 | .666 | 9.03 |
| 1919–20. | | | | | |
| October | 8,010 | 1,370 | 3,060 | .461 | .53 |
| November | 9,680 | 2,200 | 3,980 | .599 | .67 |
| December | 2,600 | 1,100 | 1,710 | .258 | .30 |
| January | 2,000 | 600 | 1,150 | .173 | .20 |
| February | 1,800 | 550 | 866 | .130 | .14 |
| March | 14,400 | 650 | 6,360 | .958 | 1.10 |
| April | 11,800 | 4,300 | 6,980 | 1.05 | 1.17 |
| May | 12,200 | 3,730 | 6,300 | .949 | 1.09 |
| June | 5,790 | 2,430 | 3,300 | .497 | .55 |
| July | 4,880 | 1,560 | 3,160 | .476 | .55 |
| August | 4,880 | 1,040 | 2,230 | .336 | .39 |
| September | 5,480 | 1,860 | 2,690 | .405 | .45 |
| The year | 14,400 | 550 | 3,490 | .526 | 7.14 |

### SHELLROCK RIVER NEAR CLARKSVILLE, IOWA.

LOCATION.—In T. 92 N., R. 16 W., at highway bridge 1¼ miles northwest of Clarksville, Butler County, and 25 miles above junction with Cedar River. No large tributaries enter for several miles above or below.

DRAINAGE AREA.—1,660 square miles at station; 2,680 square miles at junction with Cedar River (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 28, 1915, to September 30, 1920.

GAGE.—Chain gage attached to handrail on upstream side of bridge, 75 feet from right abutment; read by Mrs. H. H. Sherburne.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of rock and sand; probably permanent. Right bank high and not subject to overflow; left bank probably subject to overflow at extreme high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 10.49 feet at 11.10 a. m. March 16 (discharge, 9,510 second-feet); minimum stage, 1.09 feet September 23 and 24 (discharge, 138 second-feet).

Maximum stage recorded during year ending September 30, 1920, 6.5 feet at 7.15 a. m. May 23 (discharge, 4,310 second-feet); minimum discharge recorded, 114 second-feet January 7, by current-meter measurement.

1915–1920: Maximum discharge recorded, 12,200 second-feet June 2, 1916; minimum discharge, estimated 100 second-feet December 10–13, 1916.

In April, 1907, a stage of about 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued.

REGULATION.—Operation of power plant at Greene, 10 miles upstream, may cause slight diurnal fluctuation at low stages.

ACCURACY.—Stage-discharge relation changed during high water of March, 1919. Rating curve used October 1, 1918, to March 16, 1919, well defined between 200 and 10,000 second-feet; curve used March 17, 1919, to September 30, 1920, well defined between 125 and 10,000 second-feet; extended beyond these limits and may be in error. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for days of no gage reading for which it was ascertained by estimation or interpolation and except for days of sudden fluctuation in stage for which it was ascertained by integrating hydrographs of stage drawn by means of several extra gage readings. Records good except for February, 1919, for which they may be in error, owing to effect of ice.

*Discharge measurements of Shellrock River near Clarksville, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| 1918. | | | | 1919. | | | |
| Oct. 13 | H. C. Beckman | 1.73 | 287 | Sept. 9 | E. D. Burchard | 1.23 | 169 |
| 1919. | | | | 1920. | | | |
| Mar. 25 | R. H. Bolster | 4.13 | 1,980 | Jan. 7 | do | 1.93 | 114 |
| May 15 | E. D. Burchard | 2.90 | 1,060 | Apr. 16 | do | 2.39 | 737 |
| July 26 | do | 1.76 | 329 | Aug. 31 | do | 1.60 | 285 |

*Daily discharge, in second-feet, of Shellrock River near Clarksville, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | |
| 1 | 272 | 1,340 | 592 | ..... | ..... | 1,410 | 1,730 | 695 | 760 | 290 | 160 |
| 2 | 272 | 1,140 | 650 | ..... | ..... | 1,330 | 1,890 | 630 | 728 | 270 | 140 |
| 3 | 255 | 1,000 | 680 | ..... | ..... | 1,330 | 1,810 | 825 | 695 | 270 | 140 |
| 4 | 255 | 870 | 650 | ..... | ..... | 1,410 | 1,730 | 1,260 | 600 | 390 | 150 |
| 5 | 255 | 805 | 650 | ..... | ..... | 1,410 | 1,650 | 1,970 | 600 | 355 | 150 |
| 6 | 255 | 740 | 650 | ..... | ..... | 1,260 | 1,570 | 1,970 | 600 | 310 | 160 |
| 7 | 255 | 740 | 650 | ..... | ..... | 2,140 | 3,870 | 1,890 | 600 | 290 | 160 |
| 8 | 240 | 805 | 650 | ..... | ..... | 6,120 | 2,860 | 1,890 | 600 | 252 | 180 |
| 9 | 240 | 870 | 805 | ..... | ..... | 5,380 | 2,300 | 1,890 | 600 | 235 | 160 |
| 10 | 255 | 870 | 2,160 | ..... | ..... | 6,120 | 1,890 | 4,090 | 570 | 235 | 180 |
| 11 | 308 | 805 | 1,980 | 435 | ..... | 7,510 | 1,570 | 7,410 | 515 | 235 | 180 |
| 12 | 325 | 772 | 1,650 | 685 | ..... | 6,240 | 1,330 | 3,660 | 460 | 252 | 160 |
| 13 | 272 | 740 | 1,340 | 935 | ..... | 5,260 | 1,180 | 2,570 | 432 | 270 | 170 |
| 14 | 272 | 680 | 1,980 | 4,010 | 1,500 | 4,900 | 1,100 | 2,220 | 662 | 270 | 170 |
| 15 | 255 | 680 | 1,730 | 2,530 | 2,940 | 5,860 | 1,040 | 1,810 | 1,330 | 270 | 180 |
| 16 | 255 | 650 | 1,500 | 1,500 | 9,380 | 6,630 | 965 | 1,730 | 1,330 | 235 | 180 |
| 17 | 255 | 1,500 | 1,340 | 1,340 | 6,240 | 6,500 | 965 | 2,860 | 600 | 220 | 170 |
| 18 | 255 | 2,630 | 1,280 | 1,280 | 4,420 | 5,140 | 895 | 2,480 | 515 | 220 | 160 |
| 19 | 240 | 2,060 | 1,200 | 1,110 | 3,660 | 4,200 | 825 | 2,140 | 488 | 220 | 192 |
| 20 | 225 | 1,900 | 1,280 | 935 | 3,350 | 3,560 | 760 | 2,050 | 460 | 205 | 160 |
| 21 | 225 | 1,420 | 1,340 | 805 | 2,950 | 3,150 | 728 | 2,480 | 432 | 205 | 160 |
| 22 | 225 | 1,200 | 1,500 | 740 | 2,480 | 2,950 | 695 | 1,650 | 405 | 205 | 160 |
| 23 | 225 | 1,060 | 1,060 | 710 | 2,300 | 2,660 | 760 | 1,410 | 380 | 192 | 140 |
| 24 | 225 | 935 | 935 | 710 | 2,140 | 2,390 | 728 | 1,260 | 355 | 160 | 140 |
| 25 | 225 | 805 | 772 | 680 | 2,050 | 2,140 | 662 | 1,100 | 332 | 160 | 140 |
| 26 | 290 | 740 | 680 | ..... | 2,050 | 1,890 | 630 | 1,040 | 332 | 170 | 140 |
| 27 | 565 | 710 | 620 | ..... | 2,300 | 1,730 | 570 | 965 | 290 | 180 | 140 |
| 28 | 3,140 | 710 | 740 | ..... | 2,140 | 1,630 | 515 | 825 | 310 | 180 | 140 |
| 29 | 2,830 | 650 | 772 | ..... | 1,810 | 1,730 | 515 | 965 | 310 | 180 | 270 |
| 30 | 1,980 | 592 | 740 | ..... | 1,730 | 1,730 | 515 | 825 | 310 | 180 | 205 |
| 31 | 1,650 | ..... | 740 | ..... | 1,570 | ..... | 488 | ..... | 290 | 180 | ..... |
| 1919–20. | | | | | | | | | | | |
| 1 | 192 | 220 | ..... | ..... | ..... | 1,570 | 1,200 | 985 | 855 | 192 | 235 |
| 2 | 192 | 220 | ..... | ..... | ..... | 1,500 | 1,060 | 920 | 758 | 192 | 320 |
| 3 | 192 | 205 | ..... | ..... | ..... | 1,270 | 985 | 758 | 660 | 192 | 348 |
| 4 | 192 | 180 | ..... | ..... | ..... | 1,120 | 855 | 630 | 600 | 180 | 790 |
| 5 | 192 | 170 | ..... | ..... | ..... | 1,120 | 790 | 570 | 540 | 180 | 865 |
| 6 | 192 | 160 | ..... | ..... | ..... | 1,120 | 725 | 512 | 790 | 180 | 725 |
| 7 | 180 | 150 | ..... | ..... | ..... | 920 | 660 | 485 | 1,810 | 220 | 708 |
| 8 | 180 | 150 | ..... | ..... | ..... | 920 | 600 | 458 | 1,810 | 180 | 692 |
| 9 | 180 | 600 | ..... | ..... | ..... | 855 | 540 | 485 | 1,730 | 220 | 1,120 |
| 10 | 160 | 1,060 | ..... | ..... | ..... | 855 | 540 | 570 | 1,500 | 205 | 855 |
| 11 | 160 | 1,120 | ..... | ..... | ..... | 855 | 692 | 540 | 1,420 | 192 | 3,450 |
| 12 | 160 | 725 | ..... | ..... | ..... | 855 | 1,340 | 512 | 1,060 | 180 | 2,050 |
| 13 | 170 | 630 | ..... | ..... | ..... | 855 | 2,050 | 458 | 985 | 170 | 1,420 |
| 14 | 160 | 540 | ..... | ..... | ..... | 855 | 1,340 | 402 | 2,220 | 170 | 1,120 |
| 15 | 160 | 458 | ..... | ..... | ..... | 790 | 985 | 348 | 1,880 | 170 | 885 |
| 16 | 160 | 430 | ..... | ..... | ..... | 758 | 855 | 855 | 1,420 | 160 | 660 |
| 17 | 160 | 430 | ..... | ..... | ..... | 692 | 790 | 855 | 1,120 | 160 | 512 |
| 18 | 160 | 402 | ..... | ..... | ..... | 660 | 725 | 985 | 855 | 150 | 458 |
| 19 | 160 | 402 | ..... | ..... | ..... | 660 | 1,270 | 985 | 758 | 140 | 430 |
| 20 | 150 | 380 | ..... | ..... | ..... | 1,270 | 1,570 | 725 | 692 | 150 | 430 |
| 21 | 150 | 360 | ..... | ..... | ..... | 1,890 | 1,270 | 630 | 660 | 920 | 430 |
| 22 | 150 | 340 | ..... | ..... | 1,970 | 1,570 | 1,270 | 540 | 600 | 1,060 | 402 |
| 23 | 150 | 320 | ..... | ..... | 1,890 | 1,420 | 4,310 | 485 | 512 | 570 | 375 |
| 24 | 150 | 298 | ..... | ..... | 1,570 | 1,200 | 2,860 | 430 | 458 | 458 | 790 |
| 25 | 140 | 298 | ..... | ..... | 2,830 | 1,060 | 2,060 | 402 | 424 | 402 | 985 |
| 26 | 125 | 255 | ..... | ..... | 4,090 | 985 | 1,270 | 348 | 396 | 320 | 725 |
| 27 | 160 | 255 | ..... | ..... | 3,050 | 1,730 | 985 | 320 | 348 | 298 | 660 |
| 28 | 140 | 235 | ..... | ..... | 2,390 | 1,500 | 855 | 320 | 320 | 235 | 540 |
| 29 | 140 | 260 | ..... | ..... | 2,050 | 1,420 | 725 | 298 | 320 | 235 | 485 |
| 30 | 170 | 280 | ..... | ..... | 1,970 | 1,270 | 600 | 1,060 | 275 | 348 | 458 |
| 31 | 220 | ..... | ..... | ..... | 1,890 | ..... | 540 | ..... | 220 | 275 | ..... |

NOTE.—Stage-discharge relation affected by ice, observations discontinued and discharge not determined, Jan. 1 to Feb. 10, 1919, Feb. 26 to Mar. 13, 1919, and Dec. 1, 1919, to Mar. 21, 1920. Discharge estimated because of ice, Nov. 29 and 30, 1919. Gage not read Feb. 12 and 19, 1919, Nov. 9 and 20–22, 1919, Mar. 25, 1920, July 25 and 26, 1920, and Sept. 7, 1920; discharge interpolated.

*Monthly discharge of Shellrock River near Clarksville, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,660 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 3,140 | 225 | 542 | 0.327 | 0.38 |
| November | 2,630 | 592 | 1,010 | .608 | .68 |
| December | 2,160 | 592 | 1,070 | .645 | .74 |
| February 11–25 | 4,040 | | | | |
| March 14–31 | 9,380 | 1,500 | 3,060 | 1.84 | 1.23 |
| April | 7,540 | 1,260 | 3,530 | 2.13 | 2.38 |
| May | 3,870 | 488 | 1,250 | .753 | .87 |
| June | 7,410 | 630 | 1,950 | 1.17 | 1.30 |
| July | 1,330 | 290 | 545 | .328 | .38 |
| August | 380 | 160 | 235 | .142 | .16 |
| September | 270 | 140 | 164 | .099 | .11 |
| 1919–20. | | | | | |
| October | 220 | 125 | 166 | .100 | .12 |
| November | 1,120 | 150 | 384 | .231 | .26 |
| March 22–31 | 4,090 | 1,570 | 2,370 | 1.43 | .53 |
| April | 1,890 | 660 | 1,120 | .675 | .75 |
| May | 4,310 | 540 | 1,170 | .705 | .81 |
| June | 1,060 | 298 | 596 | .359 | .40 |
| July | 2,220 | 220 | 903 | .544 | .63 |
| August | 1,060 | 140 | 281 | .169 | .19 |
| September | 3,450 | 235 | 796 | .480 | .54 |

### SKUNK RIVER NEAR AMES, IOWA.

LOCATION.—In sec. 23, T. 84 N., R. 24 W., at site of old county bridge 2½ miles north of Ames, Story County, 5 miles above mouth of Squaw Creek, and 3½ miles below Keigley Branch.

DRAINAGE AREA.—320 square miles (measured on topographic map and on United States post-route map.)

RECORDS AVAILABLE.—July 28 to September 30, 1920.

GAGE.—Inclined staff gage on left bank; read by W. P. Coon.

DISCHARGE MEASUREMENTS.—Made from new county highway bridge one-quarter of a mile downstream from gage or by wading.

CHANNEL AND CONTROL.—Control is a rock ledge; permanent. Left bank will not be overflowed; right bank subject to overflow at extreme high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 5.3 feet at 5.25 p. m. September 9 (discharge, 1,040 second-feet); minimum stage, 1.75 feet September 1 (discharge, about 2 second-feet).

ICE.—Stage-discharge relation probably affected by ice for brief periods during extremely cold weather.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 5 and 1,200 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for July 31 and August 1 for which no gage readings were obtained and discharge was interpolated. Records excellent.

*Discharge measurements of Skunk River near Ames, Iowa, during the year ending Sept. 30, 1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Oct. 5[a] | | 942 | Sept. 6 | 2.18 | 28 | Sept. 14 | 3.11 | 177 |
| Nov. 10[a] | | 2,090 | 9 | 5.18 | 984 | 18 | 2.63 | 80 |
| 11[a] | | 1,700 | 11 | 4.29 | 549 | 24 | 2.36 | 47 |
| July 29 | 2.06 | 17.6 | 12 | 3.57 | 305 | | | |

[a] Measurement made from highway bridge above C. & N. W. Railroad bridge and 2 miles below gage.

*Daily discharge, in second-feet, of Skunk River near Ames, Iowa, for the period July 28 to Sept. 30, 1920.*

| Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 10 | 2 | 11 | | 8 | 518 | 21 | | 222 | 55 |
| 2 | | 10 | 3 | 12 | | 8 | 325 | 22 | | 197 | 52 |
| 3 | | 9 | 11 | 13 | | 8 | 236 | 23 | | 173 | 50 |
| 4 | | 8 | 65 | 14 | | 19 | 173 | 24 | | 29 | 48 |
| 5 | | 8 | 31 | 15 | | 31 | 147 | 25 | | 19 | 48 |
| 6 | | 11 | 42 | 16 | | 8 | 117 | 26 | | 65 | 34 |
| 7 | | 24 | 40 | 17 | | 11 | 90 | 27 | | 11 | 26 |
| 8 | | 11 | 111 | 18 | | 9 | 84 | 28 | 16 | 8 | 33 |
| 9 | | 8 | 518 | 19 | | 4 | 66 | 29 | 13 | 5 | 29 |
| 10 | | 8 | 984 | 20 | | 79 | 60 | 30 | 11 | 4 | 27 |
| | | | | | | | | 31 | 11 | 2 | |

*Monthly discharge of Skunk River near Ames, Iowa, for the period July 28 to Sept. 30, 1920.*

[Drainage area, 320 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| August | 222 | 2 | 33.1 | 0.103 | 0.12 |
| September | 984 | 2 | 134 | .419 | .47 |

### SKUNK RIVER AT COPPOCK, IOWA.

LOCATION.—In sec. 1, T. 73 N., R. 8 W., at highway bridge one-eighth of a mile above Chicago, Burlington & Quincy Railroad bridge at Coppock, Henry County, and a quarter of a mile above junction with Crooked Creek.

DRAINAGE AREA.—2,890 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 21, 1913, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge; read by J. W. Ricks.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.02 feet at 11 a. m. March 17 (discharge, 11,700 second-feet); minimum stage, 2.36 feet September 16 (discharge, 82 second-feet).

Maximum stage recorded during year ending September 30, 1920, 15.43 feet at 10 a. m. March 27 (discharge, 12,300 second-feet); minimum stage, 2.83 feet at 12.30 p. m. August 31 (discharge, 240 second-feet).

1913–1920: Maximum stage recorded, 19.7 feet June 9, 1918 (discharge, 19,600 second-feet); minimum stage, 2.10 feet August 15, 18, and 25–27, 1914 (discharge, 33 second-feet).

A stage of about 22 feet (discharge, 25,000 second-feet) was reached on or about May 31, 1903.

ICE.—Stage-discharge relation affected by ice; observations discontinued during periods of ice effect.

ACCURACY.—Stage-discharge relation changed during winter of 1918–19, and on July 15, 1920; seriously affected by ice. Three fairly well defined rating curves used, applicable respectively, October 1 to December 25, 1918, February 12, 1919, to July 15, 1920, and July 16 to September 30, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Skunk River at Coppock, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 26 | H. C. Beckman | 2.52 | 96 | Dec. 29[a] | C. Herlofson | 5.73 | 928 |
| 1919. | | | | 1920. | | | |
| July 24 | C. Herlofson | 3.45 | 369 | June 29 | do | 3.93 | 542 |
| Sept. 9 | do | 2.50 | 108 | Aug. 11 | E. D. Burchard | 3.52 | 485 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 114 | 310 | 250 | | | 500 | 1,510 | 4,060 | 1,150 | 979 | 282 | 139 |
| 2 | 114 | 295 | 228 | | | 500 | 1,390 | 3,880 | 3,530 | 924 | 768 | 139 |
| 3 | 104 | 250 | 179 | | | 500 | 1,390 | 7,610 | 4,150 | 870 | 584 | 139 |
| 4 | 104 | 226 | 157 | | | 550 | 1,330 | 9,380 | 5,470 | 924 | 672 | 128 |
| 5 | 104 | 202 | 202 | | | 700 | 1,330 | 10,100 | 6,370 | 979 | 461 | 128 |
| 6 | 95 | 190 | 179 | | 300 | 800 | 1,330 | 9,520 | 6,260 | 870 | 384 | 116 |
| 7 | 95 | 190 | 179 | | | 600 | 1,270 | 8,670 | 6,500 | 1,090 | 365 | 116 |
| 8 | 95 | 179 | 168 | | | 768 | 1,330 | 8,670 | 7,360 | 768 | 870 | 116 |
| 9 | 95 | 179 | 168 | | | 768 | 1,330 | 8,000 | 8,130 | 672 | 719 | 104 |
| 10 | 92 | 179 | 179 | | | 818 | 1,980 | 7,230 | 7,740 | 672 | 584 | 100 |
| | | | | 125 | | | | | | | | |
| 11 | 95 | 168 | 202 | | | 1,150 | 2,800 | 6,620 | 5,150 | 818 | 481 | 98 |
| 12 | 92 | 157 | 226 | | 314 | 1,770 | 3,200 | 5,690 | 4,240 | 1,390 | 366 | 93 |
| 13 | 90 | 157 | 226 | | 348 | 2,120 | 3,010 | 5,150 | 3,620 | 818 | 331 | 85 |
| 14 | 88 | 157 | 280 | | 627 | 1,770 | 3,440 | 4,440 | 3,200 | 672 | 298 | 85 |
| 15 | 86 | 157 | 310 | | 719 | 1,450 | 4,640 | 3,280 | 3,010 | 672 | 331 | 85 |
| 16 | 95 | 146 | 310 | | 627 | 9,810 | 4,540 | 2,720 | 2,800 | 627 | 442 | 82 |
| 17 | 114 | 168 | 310 | | 818 | 11,500 | 4,440 | 2,340 | 2,560 | 672 | 481 | 85 |
| 18 | 104 | 179 | 310 | | 768 | 11,300 | 4,240 | 2,120 | 2,420 | 584 | 442 | 89 |
| 19 | 95 | 190 | 295 | | 719 | 9,230 | 3,960 | 1,980 | 2,120 | 501 | 366 | 139 |
| 20 | 95 | 202 | 280 | | 768 | 7,870 | 3,700 | 1,840 | 2,260 | 461 | 298 | 150 |
| 21 | 95 | 214 | 295 | | 768 | 6,740 | 3,530 | 1,770 | 2,190 | 461 | 252 | 298 |
| 22 | 104 | 190 | 280 | | 719 | 5,360 | 4,060 | 1,700 | 2,880 | 422 | 224 | 1,390 |
| 23 | 95 | 168 | 340 | | 672 | 4,640 | 4,740 | 1,640 | 2,420 | 403 | 211 | 1,270 |
| 24 | 104 | 135 | 480 | | 672 | 4,060 | 4,060 | 1,580 | 2,050 | 384 | 198 | 1,040 |
| 25 | 95 | 135 | 440 | | 627 | 2,960 | 3,530 | 1,450 | 1,840 | 366 | 185 | 584 |
| | | | | 500 | | | | | | | | |
| 26 | 95 | 168 | 400 | | 550 | 2,490 | 3,530 | 1,390 | 1,700 | 348 | 173 | 481 |
| 27 | 114 | 179 | 300 | | 500 | 2,260 | 3,440 | 1,330 | 1,450 | 314 | 173 | 384 |
| 28 | 157 | 179 | 300 | | 500 | 2,050 | 3,880 | 1,270 | 1,330 | 298 | 162 | 314 |
| 29 | 157 | 179 | 250 | | ..... | 1,910 | 3,960 | 1,150 | 1,150 | 331 | 139 | 298 |
| 30 | 202 | 280 | 250 | | ..... | 1,770 | 3,960 | 1,090 | 1,090 | 298 | 162 | 542 |
| 31 | 280 | ..... | 200 | | ..... | 1,640 | ..... | 1,040 | ..... | 265 | 150 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 1,980 | 1,980 | 1,640 | | | 500 | 5,800 | 4,740 | 1,580 | 501 | 396 | 288 |
| 2 | 2,340 | 1,700 | 1,100 | | | 500 | 6,860 | 4,540 | 3,010 | 542 | 380 | 317 |
| 3 | 2,880 | 1,580 | 800 | | | 1,000 | 5,690 | 4,240 | 2,880 | 627 | 364 | 274 |
| 4 | 3,280 | 1,330 | 900 | | | 1,100 | 4,740 | 3,700 | 2,050 | 698 | 348 | 302 |
| 5 | 3,530 | 1,330 | 1,000 | | | 1,600 | 4,240 | 3,440 | 1,640 | 768 | 332 | 380 |
| | | | | | 500 | | | | | | | |
| 6 | 3,780 | 1,270 | 1,200 | | | 2,200 | 4,150 | 3,200 | 1,390 | 1,040 | 332 | 380 |
| 7 | 3,960 | 1,270 | 1,200 | | | 2,500 | 4,060 | 2,960 | 1,390 | 2,340 | 348 | 364 |
| 8 | 2,960 | 1,580 | 1,200 | | | 2,700 | 3,620 | 2,560 | 1,700 | 2,050 | 317 | 540 |
| 9 | 2,640 | 1,700 | 1,100 | | | 4,000 | 2,960 | 2,260 | 1,330 | 1,980 | 317 | 482 |
| 10 | 2,560 | 5,910 | 1,100 | | | 4,000 | 2,560 | 2,120 | 1,390 | 1,700 | 332 | 464 |
| 11 | 2,560 | 6,140 | 1,100 | | | 4,500 | 2,420 | 2,050 | 1,330 | 1,390 | 404 | 501 |
| 12 | 2,560 | 5,690 | 1,100 | | | 6,000 | 2,260 | 5,470 | 1,150 | 1,210 | 413 | 890 |
| 13 | 2,050 | 5,470 | 900 | | | 5,500 | 2,190 | 7,870 | 1,080 | 1,150 | 348 | 1,340 |
| 14 | 1,580 | 5,800 | 900 | | 1,200 | 4,800 | 2,190 | 7,230 | 924 | 1,390 | 317 | 1,460 |
| 15 | 1,270 | 5,800 | 900 | | | 5,040 | 2,120 | 5,800 | 818 | 1,840 | 317 | 1,340 |
| | | | | 500 | | | | | | | | |
| 16 | 1,390 | 5,260 | 900 | | | 5,470 | 2,340 | 5,470 | 768 | 1,720 | 302 | 1,220 |
| 17 | 1,330 | 4,640 | 900 | | | 5,470 | 2,190 | 5,010 | 768 | 1,780 | 302 | 840 |
| 18 | 1,210 | 4,540 | 900 | | | 5,910 | 2,420 | 5,260 | 719 | 1,340 | 302 | 690 |
| 19 | 1,090 | 4,440 | 900 | | | 5,580 | 4,060 | 5,260 | 672 | 1,060 | 302 | 600 |
| 20 | 979 | 4,060 | 800 | | | 5,800 | 8,930 | 5,040 | 672 | 940 | 288 | 540 |
| 21 | 924 | 3,040 | 800 | | | 4,640 | 7,870 | 4,840 | 672 | 790 | 288 | 501 |
| 22 | 870 | 2,490 | 800 | | | 3,360 | 6,370 | 4,540 | 584 | 740 | 274 | 413 |
| 23 | 818 | 2,340 | 750 | | | 2,880 | 6,860 | 3,530 | 672 | 640 | 260 | 430 |
| 24 | 768 | 2,190 | 700 | | 500 | 2,720 | 7,740 | 2,880 | 672 | 640 | 286 | 396 |
| 25 | 768 | 2,050 | 700 | | | 8,950 | 6,740 | 2,720 | 627 | 600 | 246 | 380 |
| 26 | 818 | 1,980 | 700 | | | 11,000 | 4,940 | 2,640 | 627 | 600 | 364 | 317 |
| 27 | 870 | 1,840 | 750 | | | 12,200 | 4,740 | 2,420 | 584 | 540 | 882 | 364 |
| 28 | 924 | 1,770 | 800 | | | 11,000 | 4,640 | 2,050 | 584 | 501 | 302 | 348 |
| 29 | 870 | 1,840 | 900 | | | 9,520 | 4,540 | 1,840 | 542 | 464 | 274 | 317 |
| 30 | 818 | 1,700 | 900 | | ..... | 8,130 | 5,470 | 1,770 | 542 | 464 | 260 | 302 |
| 31 | 3,780 | ..... | 900 | | ..... | 6,860 | ..... | 1,640 | ..... | 413 | 246 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 26, 1918, to Feb. 11, 1919, Feb. 26 to Mar. 7, 1919, and Dec. 2, 1919, to Mar. 14, 1920; mean discharge ascertained by means of one discharge measurement, observer's notes, weather records, and comparison with flow of Skunk River at Augusta, Iowa. Observations discontinued Jan. 1 to Feb. 11, 1919, and Jan. 1 to Mar. 13, 1920, because of ice. Gage not read, discharge interpolated, Nov. 28, 1918, July 4, 1919, and July 4, 1920. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Skunk River at Coppock, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,890 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 280 | 86 | 112 | 0.039 | 0.04 |
| November | 310 | 135 | 190 | .066 | .07 |
| December | 480 | 157 | 264 | .091 | .10 |
| January | | | 258 | .089 | .10 |
| February | 818 | | 501 | .173 | .18 |
| March | 11,500 | 500 | 3,240 | 1.12 | 1.29 |
| April | 4,740 | 1,270 | 3,030 | 1.05 | 1.17 |
| May | 10,100 | 1,040 | 4,150 | 1.44 | 1.66 |
| June | 8,130 | 1,090 | 3,540 | 1.22 | 1.36 |
| July | 1,390 | 265 | 640 | .221 | .25 |
| August | 870 | 139 | 373 | .129 | .15 |
| September | 1,390 | 82 | 294 | .102 | .11 |
| The year | 11,500 | 82 | 1,390 | .481 | 6.48 |
| 1919-20. | | | | | |
| October | 3,960 | 768 | 1,880 | .651 | .75 |
| November | 6,140 | 1,270 | 3,090 | 1.07 | 1.19 |
| December | 1,640 | 700 | 943 | .326 | .38 |
| January | | | 500 | .173 | .20 |
| February | | | 717 | .248 | .27 |
| March | 12,200 | 500 | 5,020 | 1.74 | 2.01 |
| April | 8,950 | 2,120 | 4,520 | 1.56 | 1.74 |
| May | 7,870 | 1,640 | 3,870 | 1.34 | 1.54 |
| June | 3,040 | 542 | 1,110 | .384 | .43 |
| July | 2,340 | 413 | 1,050 | .363 | .42 |
| August | 464 | 246 | 320 | .111 | .13 |
| September | 1,460 | 274 | 566 | .196 | .22 |
| The year | 12,200 | 246 | 1,970 | .682 | 9.28 |

### SKUNK RIVER AT AUGUSTA, IOWA.

LOCATION.—In sec. 26, T. 69 N., R. 4 W., at highway bridge a third of a mile from Augusta post office, Des Moines County, and 12.2 miles from mouth of Skunk River where it empties into pond of Mississippi River Power Co., 32.2 miles above dam at Keokuk, Iowa.

DRAINAGE AREA.—At gaging station 4,290 square miles; at mouth 4,350 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 1 to November 15, 1913; May 27, 1915, to September 30, 1920.

GAGE.—Chain gage attached to downstream handrail of bridge about 95 feet from left abutment; read once daily by L. E. Williamson. Zero of chain gage 528.55 feet above mean sea level, Memphis datum. Staff gage attached to downstream left side of middle pier, used by engineers of the Hydraulic Engineering Co. of Maine during 1913; taken out by ice in spring of 1914. Datum of staff gage approximately 0.73 foot higher than datum of chain gage.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; shifting. Right bank high and is not overflowed; left bank is overflowed at extreme high stages. Remains of old mill dam 600 feet below gage forms control; permanent. The fall over the dam is about 3 feet at medium low stages. Backwater from Mississippi River occurs once in about 50 years.

REGULATION.—Natural discharge at Augusta occasionally affected at extreme low stages, by storage of water at Oakland Mills, 30 miles upstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.25 feet at 3 p. m. May 4 (discharge, 21,600 second-feet); minimum stage, 1.29 feet September 8 (discharge, 26 second-feet, by current-meter measurement); minimum caused by artificial regulation.

Maximum stage recorded during year ending September 30, 1920, 16.25 feet at 7 a. m. April 21 (discharge, 24,500 second-feet); minimum stage, 2.03 feet August 27 and September 2 (discharge, 244 second-feet).

1913; 1915–1920: Maximum discharge recorded, 30,800 second-feet March 28, 1916; minimum stage, 1.29 feet September 8, 1919 (discharge, 26 second-feet, by current-meter measurement).

A stage of about 21 feet (discharge, 45,000 second-feet) was reached on or about June 1, 1903. Natural minimum discharge at this station, probably 25 second-feet or less.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. One rating curve used during period; well defined between 20 and 35,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records excellent except for periods of low stage January 24, 1916, to July 17, 1919, for which they are only fair on account of uncertain error in gage readings caused by use of corroded iron chain; winter records good.

*Discharge measurements of Skunk River at Augusta, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| July 18 | Herlofson & Reiner | 2.69 | 656 | Jan. 16[a] | C. Herlofson | 2.82 | 655 |
| Aug. 26 | C. Herlofson | 2.00 | 229 | Feb. 18[a] | do | 3.11 | 1,000 |
| Sept. 8 | do | 1.29 | 26 | June 30 | do | 2.79 | 752 |
| Dec. 17[a] | do | 3.69 | 918 | Aug. 18 | do | 2.11 | 283 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the period May 27, 1915, to Sept. 30, 1920.*

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1915. | | | | | | 1915. | | | | | |
| 1 | | 6,640 | 4,820 | 15,900 | 1,200 | 16 | | 4,040 | 4,200 | 3,880 | 6,080 |
| 2 | | 5,660 | 3,550 | 14,100 | 1,260 | 17 | | 2,670 | 3,880 | 2,940 | 8,040 |
| 3 | | 5,100 | 2,160 | 19,100 | 1,670 | 18 | | 2,410 | 2,800 | 2,410 | 8,880 |
| 4 | | 4,820 | 1,790 | 19,900 | 1,370 | 19 | | 2,410 | 4,960 | 2,410 | 13,500 |
| 5 | | 5,240 | 1,550 | 19,400 | 1,320 | 20 | | 4,560 | 5,520 | 2,410 | 8,460 |
| 6 | | 5,660 | 1,320 | 19,600 | 1,200 | 21 | | 4,040 | 4,820 | 2,160 | 6,640 |
| 7 | | 6,500 | 2,670 | 15,900 | 1,260 | 22 | | 3,880 | 4,040 | 2,040 | 3,880 |
| 8 | | 7,480 | 2,280 | 11,200 | 1,260 | 23 | | 3,880 | 3,400 | 1,910 | 3,090 |
| 9 | | 7,760 | 1,790 | 7,760 | 2,800 | 24 | | 3,550 | 6,080 | 1,910 | 2,410 |
| 10 | | 7,340 | 1,550 | 6,640 | 4,390 | 25 | | 2,940 | 11,600 | 1,790 | 2,670 |
| 11 | | 7,060 | 22,000 | 6,500 | 6,220 | 26 | | 2,670 | 11,000 | 1,670 | 3,240 |
| 12 | | 6,780 | 20,100 | 6,220 | 6,080 | 27 | 10,800 | 3,550 | 10,800 | 1,430 | 5,660 |
| 13 | | 8,740 | 11,300 | 5,940 | 5,800 | 28 | 10,400 | 2,940 | 10,600 | 1,430 | 8,460 |
| 14 | | 8,460 | 6,780 | 4,689 | 5,520 | 29 | 9,300 | 2,670 | 18,200 | 1,370 | 9,720 |
| 15 | | 7,340 | 6,080 | 4,220 | 5,800 | 30 | 8,740 | 2,160 | 15,900 | 1,260 | 10,000 |
| | | | | | | 31 | 7,900 | | 18,900 | 1,200 | |

*Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the period May 27, 1915, to Sept. 30, 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1915–16. | | | | | | | | | | | | |
| 1 | 9,580 | 1,790 | 2,160 | 1,500 | 3,000 | 8,000 | 5,520 | 1,670 | 3,240 | 975 | 275 | 275 |
| 2 | 10,100 | 1,670 | 1,790 | 3,000 | 2,000 | 8,000 | 4,390 | 1,550 | 2,940 | 1,080 | 468 | 230 |
| 3 | 10,600 | 1,550 | 1,670 | 4,000 | 2,000 | 8,000 | 4,040 | 3,880 | 3,090 | 975 | 325 | 252 |
| 4 | 10,700 | 1,430 | 1,430 | 5,000 | 1,500 | 7,000 | 3,240 | 3,880 | 2,670 | 538 | 300 | 200 |
| 5 | 10,100 | 1,430 | 1,430 | 4,000 | 1,300 | 7,000 | 2,670 | 3,240 | 2,160 | 575 | 300 | 200 |
| 6 | 8,740 | 1,430 | 1,370 | 3,000 | 1,200 | 6,000 | 2,540 | 2,940 | 12,100 | 665 | 300 | 6,780 |
| 7 | 7,340 | 1,430 | 1,320 | 2,000 | 1,200 | 5,160 | 2,160 | 2,540 | 17,900 | 620 | 300 | 3,880 |
| 8 | 7,480 | 1,430 | 1,260 | 2,000 | 1,000 | 3,880 | 2,160 | 2,160 | 11,600 | 975 | 275 | 2,410 |
| 9 | 7,900 | 1,370 | 1,200 | 2,000 | 1,000 | 2,940 | 2,040 | 1,910 | 7,060 | 870 | 275 | 1,140 |
| 10 | 7,620 | 1,320 | 1,200 | 2,000 | 1,000 | 2,410 | 1,910 | 1,790 | 6,220 | 715 | 325 | 818 |
| 11 | 7,340 | 1,320 | 1,320 | 2,000 | 1,000 | 1,910 | 1,670 | 1,670 | 2,670 | 575 | 250 | 468 |
| 12 | 5,940 | 1,260 | 1,260 | 1,500 | 1,000 | 1,670 | 1,550 | 1,550 | 2,410 | 538 | 250 | 352 |
| 13 | 5,380 | 1,370 | 1,140 | 1,000 | 1,000 | 1,670 | 1,430 | 6,920 | 2,160 | 538 | 922 | 275 |
| 14 | 5,100 | 1,430 | 870 | 800 | 1,000 | 1,670 | 1,430 | 13,500 | 1,670 | 500 | 870 | 275 |
| 15 | 4,390 | 1,670 | | 800 | 1,000 | 1,670 | 1,430 | 14,100 | 1,430 | 620 | 665 | 275 |
| 16 | 3,400 | 2,040 | | 800 | 1,000 | 1,670 | 1,430 | 11,600 | 1,320 | 538 | 380 | 275 |
| 17 | 2,940 | 2,160 | | 800 | 1,200 | 1,790 | 1,430 | 8,660 | 1,430 | 435 | 380 | 275 |
| 18 | 2,940 | 2,160 | | 800 | 3,000 | 1,670 | 1,430 | 7,340 | 1,320 | 500 | 408 | 190 |
| 19 | 2,940 | 2,040 | | 800 | 5,000 | 1,670 | 1,430 | 5,940 | 1,260 | 575 | 408 | 200 |
| 20 | 2,800 | 1,910 | | 1,000 | 5,000 | 1,790 | 1,430 | 4,040 | 1,140 | 575 | 325 | 200 |
| 21 | 2,670 | 1,790 | | 7,000 | 6,000 | 1,670 | 1,550 | 3,880 | 2,940 | 1,320 | 275 | 200 |
| 22 | 2,540 | 1,670 | | 12,000 | 8,000 | 1,550 | 1,670 | 4,220 | 2,160 | 870 | 230 | 175 |
| 23 | 2,410 | 1,670 | 800 | 15,400 | 8,000 | 1,670 | 1,670 | 4,390 | 1,910 | 500 | 190 | 175 |
| 24 | 2,410 | 1,550 | | 18,000 | 10,000 | 1,670 | 1,430 | 7,760 | 2,160 | 435 | 190 | 175 |
| 25 | 2,280 | 1,430 | | 12,000 | 7,500 | 1,790 | 1,430 | 8,320 | 1,670 | 435 | 172 | 150 |
| 26 | 2,160 | 4,820 | | 10,000 | 6,000 | 10,700 | 1,430 | 7,030 | 1,670 | 975 | 200 | 150 |
| 27 | 2,160 | 4,220 | | 15,000 | 6,000 | 24,300 | 1,430 | 13,000 | 1,670 | 408 | 200 | 500 |
| 28 | 1,910 | 3,550 | | 15,000 | 6,500 | 30,800 | 1,430 | 5,380 | 1,320 | 408 | 190 | 500 |
| 29 | 1,910 | 2,940 | | 11,000 | 7,500 | 27,000 | 1,430 | 4,560 | 1,030 | 275 | 172 | 715 |
| 30 | 1,790 | 2,410 | | 8,000 | ..... | 21,000 | 1,430 | 3,880 | 870 | 230 | 200 | 538 |
| 31 | 1,790 | ..... | | 5,380 | ..... | 9,020 | ..... | 3,240 | ..... | 300 | 200 | ..... |
| 1916–17. | | | | | | | | | | | | |
| 1 | 325 | 210 | 468 | | | 200 | 1,430 | 13,700 | 2,280 | 1,910 | 665 | 350 |
| 2 | 300 | 190 | 408 | | | 200 | 1,430 | 12,000 | 3,550 | 1,670 | 620 | 350 |
| 3 | 210 | 190 | 300 | | | 200 | 1,320 | 9,580 | 4,220 | 1,550 | 500 | 380 |
| 4 | 138 | 180 | 275 | | | 150 | 1,200 | 6,080 | 9,160 | 1,430 | 575 | 408 |
| 5 | 122 | 172 | 300 | | | 150 | 1,030 | 7,960 | 18,400 | 1,140 | 575 | 2,670 |
| 6 | 108 | 190 | 300 | 200 | | 150 | 975 | 7,340 | 24,600 | 1,030 | 500 | 1,790 |
| 7 | 108 | 194 | 275 | | | 200 | 922 | 5,100 | 27,000 | 975 | 435 | 1,670 |
| 8 | 93 | 210 | 275 | | | 300 | 1,200 | 4,560 | 25,600 | 922 | 468 | 1,670 |
| 9 | 80 | 715 | 275 | | | 500 | 1,260 | 3,240 | 24,300 | 1,140 | 975 | 922 |
| 10 | 93 | 818 | 250 | | 150 | 1,000 | 1,430 | 2,940 | 19,100 | 1,080 | 500 | 818 |
| 11 | 93 | 818 | 250 | | | 2,000 | 1,430 | 2,540 | 13,200 | 1,030 | 468 | 435 |
| 12 | 68 | 715 | 250 | | | 3,000 | 1,320 | 2,280 | 10,700 | 1,080 | 325 | 350 |
| 13 | 80 | 538 | 100 | | | 4,220 | 1,430 | 2,160 | 17,000 | 975 | 275 | 300 |
| 14 | 93 | 380 | | | | 12,100 | 1,370 | 1,910 | 14,500 | 750 | 275 | 325 |
| 15 | 68 | 300 | | 150 | | 10,600 | 1,260 | 1,670 | 15,700 | 620 | 275 | 300 |
| 16 | 57 | 252 | | | | 8,460 | 1,080 | 1,550 | 19,900 | 538 | 300 | 325 |
| 17 | 68 | 210 | | | | 7,340 | 1,550 | 1,430 | 18,900 | 500 | 300 | 300 |
| 18 | 80 | 210 | | | | 6,500 | 1,550 | 1,430 | 15,300 | 538 | 210 | 300 |
| 19 | 108 | 190 | | 140 | | 5,660 | 1,670 | 1,430 | 14,500 | 870 | 210 | 275 |
| 20 | 113 | 218 | | 130 | | 3,880 | 2,160 | 1,080 | 10,700 | 922 | 172 | 275 |
| 21 | 122 | 214 | 120 | 130 | | 3,400 | 2,160 | 1,030 | 9,720 | 870 | 300 | 275 |
| 22 | 120 | 230 | | 200 | | 3,240 | 2,160 | 5,240 | 8,740 | 870 | 210 | 275 |
| 23 | 93 | 252 | | 1,000 | 200 | 2,940 | 1,910 | 10,600 | 6,780 | 975 | 300 | 250 |
| 24 | 138 | 230 | | 800 | | 2,940 | 1,910 | 9,160 | 5,660 | 922 | 300 | 250 |
| 25 | 575 | 138 | | 600 | | 2,800 | 2,410 | 5,800 | 4,820 | 870 | 380 | 250 |
| 26 | 1,030 | 172 | | 400 | | 2,670 | 2,160 | 3,880 | 4,220 | 665 | 340 | 200 |
| 27 | 1,030 | 380 | | 300 | | 2,670 | 1,910 | 3,550 | 2,940 | 620 | 300 | 210 |
| 28 | 975 | 468 | 140 | 200 | | 2,410 | 1,910 | 3,550 | 2,670 | 922 | 300 | 162 |
| 29 | 715 | 620 | 150 | 200 | ..... | 2,160 | 2,280 | 3,550 | 2,410 | 870 | 300 | 180 |
| 30 | 352 | 538 | 150 | 200 | ..... | 1,670 | 4,390 | 2,160 | 2,410 | 922 | 380 | 172 |
| 31 | 252 | ..... | 150 | 200 | ..... | 1,430 | ..... | 2,160 | ..... | 750 | 300 | ..... |

*Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the period May 27, 1915, to Sept. 30, 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1917–18. | | | | | | | | | | | | |
| 1 | 172 | 162 | 145 | | | 1,030 | 435 | 352 | 7,760 | 3,240 | 620 | 1,370 |
| 2 | 155 | 155 | 190 | 70 | | 975 | 467 | 300 | 6,220 | 3,240 | 620 | 2,160 |
| 3 | 172 | 153 | 145 | | | 1,200 | 467 | 300 | 4,390 | 2,940 | 620 | 3,400 |
| 4 | 155 | 190 | 155 | | 40 | 1,670 | 500 | 300 | 4,220 | 2,540 | 467 | 2,410 |
| 5 | 138 | 155 | 172 | | | 2,670 | 467 | 325 | 4,560 | 2,160 | 467 | 1,670 |
| 6 | 138 | 155 | 140 | 60 | | 2,670 | 352 | 300 | 12,000 | 1,430 | 467 | 1,200 |
| 7 | 129 | 172 | 120 | | | 1,430 | 575 | 300 | 11,800 | 1,430 | 467 | 1,080 |
| 8 | 138 | 155 | 100 | | 50 | 1,320 | 537 | 300 | 11,800 | 1,430 | 467 | 870 |
| 9 | 122 | 162 | 80 | | 60 | 1,030 | 435 | 2,160 | 14,500 | 2,940 | 467 | 715 |
| 10 | 107 | 172 | 80 | | 100 | 870 | 380 | 1,800 | 18,200 | 2,040 | 467 | 537 |
| 11 | 99 | 138 | 80 | | 300 | 817 | 352 | 1,430 | 25,600 | 1,670 | 325 | 435 |
| 12 | 98 | 155 | 80 | | 1,000 | 817 | 352 | 575 | 25,300 | 1,790 | 252 | 407 |
| 13 | 86 | 122 | 80 | | 3,000 | 817 | 325 | 467 | 18,900 | 1,910 | 325 | 325 |
| 14 | 80 | 138 | 60 | 50 | 4,000 | 665 | 350 | 407 | 13,700 | 1,260 | 275 | 325 |
| 15 | 86 | 138 | 60 | | 4,560 | 620 | 380 | 300 | 11,000 | 1,370 | 275 | 300 |
| 16 | 93 | 155 | 60 | | 3,880 | 620 | 407 | 325 | 8,460 | 1,670 | 262 | 275 |
| 17 | 80 | 122 | 60 | | 3,880 | 620 | 380 | 325 | 7,620 | 1,370 | 252 | 252 |
| 18 | 93 | 138 | 60 | | 3,500 | 620 | 467 | 380 | 5,940 | 1,200 | 2,040 | 252 |
| 19 | 155 | 122 | 60 | | 3,000 | 575 | 575 | 500 | 4,820 | 975 | 2,040 | 210 |
| 20 | 172 | 122 | 80 | | 2,000 | 537 | 620 | 537 | 3,880 | 715 | 1,200 | 230 |
| 21 | 155 | 113 | 100 | | 1,000 | 537 | 715 | 575 | 3,090 | 665 | 1,030 | 252 |
| 22 | 155 | 122 | 100 | | 1,000 | 537 | 620 | 1,670 | 2,670 | 620 | 975 | 275 |
| 23 | 155 | 122 | 100 | | 1,000 | 575 | 500 | 2,040 | 1,790 | 620 | 922 | 230 |
| 24 | 138 | 122 | 150 | | 1,000 | 575 | 435 | 9,580 | 1,670 | 500 | 1,200 | 210 |
| 25 | 138 | 122 | 175 | 40 | 1,000 | 537 | 435 | 7,340 | 8,460 | 467 | 1,260 | 240 |
| 26 | 172 | 138 | 120 | | 1,000 | 537 | 407 | 6,360 | 5,660 | 435 | 1,370 | 275 |
| 27 | 190 | 122 | 100 | | 1,000 | 500 | 407 | 4,390 | 5,100 | 435 | 2,160 | 252 |
| 28 | 216 | 145 | 100 | | 1,000 | 500 | 407 | 5,520 | 3,550 | 435 | 1,550 | 230 |
| 29 | 172 | 138 | 80 | | ..... | 435 | 407 | 9,300 | 3,240 | 922 | 1,370 | 240 |
| 30 | 138 | 190 | 80 | | ..... | 407 | 407 | 14,100 | 3,240 | 870 | 1,030 | 240 |
| 31 | 210 | ..... | 70 | | ..... | 467 | ..... | 9,020 | ..... | 665 | 922 | ..... |
| 1918–19. | | | | | | | | | | | | |
| 1 | 252 | 190 | 380 | 250 | 870 | 975 | 1,910 | 4,960 | 1,550 | 1,430 | 2,800 | 176 |
| 2 | 200 | 219 | 380 | 225 | 620 | 870 | 1,790 | 5,100 | 6,360 | 1,430 | 922 | 165 |
| 3 | 200 | 230 | 352 | 200 | 538 | 715 | 1,910 | 9,300 | 7,060 | 1,430 | 817 | 155 |
| 4 | 200 | 275 | 380 | 150 | 500 | 765 | 1,910 | 21,400 | 8,880 | 1,430 | 765 | 149 |
| 5 | 200 | 352 | 380 | 150 | 538 | 1,080 | 1,910 | 19,400 | 10,100 | 2,840 | 620 | 155 |
| 6 | 200 | 380 | 408 | 150 | 500 | 1,260 | 1,910 | 15,700 | 8,740 | 2,280 | 467 | 148 |
| 7 | 190 | 325 | 380 | 200 | 468 | 975 | 1,790 | 18,200 | 8,040 | 1,320 | 467 | 42 |
| 8 | 172 | 300 | 408 | 200 | 352 | 1,030 | 1,670 | 13,000 | 8,040 | 1,080 | 620 | 27 |
| 9 | 175 | 300 | 380 | 200 | 500 | 1,030 | 1,670 | 11,600 | 8,740 | 922 | 575 | 102 |
| 10 | 175 | 300 | 352 | 200 | 435 | 1,030 | 1,670 | 9,020 | 8,660 | 818 | 575 | 262 |
| 11 | 175 | 275 | 380 | 200 | 352 | 1,200 | 1,790 | 8,180 | 7,060 | 765 | 620 | 190 |
| 12 | 175 | 300 | 380 | 150 | 500 | 1,790 | 1,910 | 7,340 | 6,780 | 715 | 665 | 155 |
| 13 | 175 | 252 | 380 | 150 | 715 | 1,910 | 3,550 | 6,360 | 5,100 | 715 | 620 | 138 |
| 14 | 150 | 252 | 408 | 150 | 1,550 | 2,410 | 4,040 | 5,940 | 3,240 | 665 | 575 | 145 |
| 15 | 150 | 300 | 408 | 150 | 1,670 | 2,160 | 5,940 | 5,520 | 2,800 | 715 | 620 | 138 |
| 16 | 150 | 352 | 435 | 200 | 1,670 | 10,400 | 6,220 | 4,960 | 2,800 | 665 | 575 | 122 |
| 17 | 150 | 252 | 435 | 200 | 1,670 | 20,400 | 6,220 | 3,880 | 2,670 | 715 | 575 | 113 |
| 18 | 175 | 275 | 468 | 250 | 1,370 | 18,900 | 5,660 | 2,940 | 2,670 | 715 | 620 | 102 |
| 19 | 175 | 300 | 538 | 300 | 1,260 | 19,900 | 5,520 | 2,670 | 2,670 | 665 | 575 | 122 |
| 20 | 175 | 252 | 500 | 350 | 1,080 | 16,100 | 4,680 | 2,540 | 2,540 | 665 | 537 | 165 |
| 21 | 175 | 230 | 500 | 400 | 1,080 | 10,300 | 4,040 | 2,280 | 2,280 | 620 | 575 | 172 |
| 22 | 175 | 275 | 500 | 600 | 1,030 | 8,180 | 4,220 | 2,160 | 2,280 | 620 | 500 | 407 |
| 23 | 175 | 275 | 500 | 800 | 1,030 | 6,780 | 6,360 | 2,280 | 2,160 | 575 | 467 | 922 |
| 24 | 175 | 252 | 538 | 1,000 | 1,140 | 5,520 | 6,360 | 2,160 | 2,160 | 500 | 435 | 1,670 |
| 25 | 175 | 230 | 450 | 1,200 | 1,430 | 4,040 | 5,380 | 2,040 | 2,040 | 435 | 275 | 1,430 |
| 26 | 175 | 252 | 400 | 1,670 | 1,430 | 3,400 | 4,820 | 1,910 | 1,790 | 435 | 230 | 1,030 |
| 27 | 175 | 239 | 350 | 1,550 | 1,320 | 3,240 | 4,390 | 1,670 | 1,670 | 467 | 214 | 1,030 |
| 28 | 200 | 275 | 350 | 1,430 | 1,080 | 2,800 | 4,220 | 1,550 | 1,550 | 435 | 210 | 922 |
| 29 | 200 | 380 | 350 | 1,080 | ..... | 2,280 | 4,820 | 1,430 | 1,430 | 435 | 198 | 1,030 |
| 30 | 200 | 380 | 300 | 975 | ..... | 1,790 | 4,820 | 1,430 | 1,550 | 435 | 190 | 2,160 |
| 31 | ..... | ..... | 300 | 922 | ..... | 1,910 | ..... | 1,430 | ..... | 435 | 190 | ..... |

*Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the period May 27, 1915, to Sept. 30, 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 2,800 | 5,380 | 2,300 | 700 | 530 | 430 | 8,180 | 7,340 | 1,910 | 620 | 408 | 266 |
| 2 | 3,550 | 3,400 | 2,100 | 700 | 530 | 500 | 8,460 | 6,500 | 2,280 | 665 | 380 | 244 |
| 3 | 2,940 | 2,410 | 1,900 | 750 | 580 | 550 | 9,020 | 5,940 | 2,940 | 870 | 380 | 352 |
| 4 | 3,880 | 2,160 | 1,800 | 750 | 580 | 1,300 | 6,780 | 5,100 | 3,240 | 715 | 380 | 352 |
| 5 | 4,390 | 1,910 | 1,900 | 750 | 580 | 1,500 | 5,660 | 3,550 | 2,540 | 922 | 352 | 315 |
| 6 | 4,560 | 1,670 | 2,000 | 700 | 580 | 2,500 | 5,380 | 4,040 | 1,910 | 2,540 | 352 | 290 |
| 7 | 4,560 | 1,550 | 2,200 | 675 | 580 | 3,200 | 5,800 | 3,550 | 1,910 | 2,160 | 325 | 315 |
| 8 | 4,560 | 1,670 | 2,000 | 675 | 540 | 3,600 | 6,220 | 3,240 | 1,670 | 2,540 | 325 | 352 |
| 9 | 4,680 | 6,360 | 1,900 | 650 | 580 | 3,800 | 5,240 | 2,670 | 2,410 | 2,160 | 1,370 | 715 |
| 10 | 4,560 | 5,520 | 1,800 | 650 | 1,060 | 5,300 | 4,220 | 2,670 | 1,910 | 2,160 | 870 | 538 |
| 11 | 4,220 | 8,460 | 1,400 | 625 | 1,830 | 5,300 | 3,550 | 2,410 | 1,670 | 1,910 | 500 | 468 |
| 12 | 4,390 | 8,460 | 1,200 | 625 | 2,300 | 6,000 | 3,240 | 10,000 | 1,670 | 1,670 | 500 | 468 |
| 13 | 4,220 | 7,620 | 1,100 | 650 | 2,500 | 8,000 | 3,880 | 17,700 | 1,320 | 1,430 | 500 | 975 |
| 14 | 4,220 | 7,060 | 1,000 | 650 | 2,300 | 7,000 | 3,550 | 15,700 | 1,200 | 3,550 | 538 | 1,370 |
| 15 | 3,550 | 7,060 | 900 | 650 | 1,830 | 6,000 | 3,240 | 9,580 | 1,080 | 3,240 | 380 | 1,430 |
| 16 | 2,800 | 6,500 | 900 | 650 | 1,570 | 6,400 | 2,940 | 7,900 | 1,030 | 2,540 | 380 | 1,550 |
| 17 | 1,670 | 5,940 | 900 | 650 | 1,230 | 6,080 | 3,090 | 9,300 | 922 | 2,410 | 266 | 1,910 |
| 18 | 1,670 | 5,100 | 900 | 610 | 1,000 | 6,220 | 3,240 | 9,160 | 870 | 1,910 | 266 | 1,320 |
| 19 | 1,550 | 4,960 | 900 | 610 | 820 | 6,780 | 6,780 | 7,620 | 818 | 1,670 | 325 | 1,030 |
| 20 | 1,430 | 4,820 | 900 | 650 | 680 | 6,640 | 18,900 | 6,920 | 765 | 1,260 | 325 | 818 |
| 21 | 1,320 | 4,390 | 800 | 650 | 580 | 6,780 | 24,300 | 6,220 | 765 | 1,030 | 352 | 715 |
| 22 | 1,260 | 2,940 | 800 | 610 | 580 | 5,380 | 12,500 | 6,080 | 715 | 922 | 315 | 620 |
| 23 | 1,200 | 2,670 | 800 | 610 | 540 | 3,880 | 9,300 | 4,960 | 765 | 870 | 315 | 408 |
| 24 | 1,140 | 2,540 | 750 | 560 | 580 | 3,240 | 9,020 | 4,390 | 715 | 715 | 315 | 468 |
| 25 | 1,080 | 2,410 | 750 | 520 | 580 | 18,900 | 9,300 | 3,400 | 665 | 665 | 290 | 468 |
| 26 | 1,030 | 2,410 | 750 | 520 | 540 | 24,300 | 8,180 | 2,940 | 665 | 665 | 266 | 468 |
| 27 | 1,140 | 2,160 | 750 | 520 | 540 | 22,000 | 7,200 | 2,940 | 620 | 620 | 244 | 538 |
| 28 | 1,030 | 2,160 | 800 | 480 | 500 | 21,200 | 7,060 | 2,670 | 575 | 620 | 315 | 500 |
| 29 | 1,080 | 2,280 | 850 | 480 | 500 | 21,400 | 6,640 | 2,410 | 575 | 575 | 290 | 435 |
| 30 | 1,140 | 2,500 | 900 | 480 | ..... | 14,100 | 5,940 | 2,160 | 665 | 538 | 290 | 408 |
| 31 | 2,670 | ..... | 900 | 480 | ..... | 10,700 | ..... | 1,910 | ..... | 468 | 266 | ..... |

NOTE.—The above table of daily discharge for the period May 27 to Sept. 30, 1915, supersedes the table published in Water-Supply Paper 405. Stage-discharge relation affected by ice, Dec. 15, 1915, to Mar. 6, 1916, Dec. 13, 1916, to Mar. 12, 1917, Dec. 6, 1917, to Feb. 14, 1918, Feb. 18–28, 1918, Dec. 25, 1918, to Jan. 25, 1919, and Nov. 30, 1919, to Mar. 16, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, weather records, and comparison with record of flow of Skunk River at Coppock, Iowa. Gage readings in error, July 31, 1916, Aug. 4–9, 11, 12, 26, 27, 30, 31, Sept. 4, 5, 19–26, Oct. 22, Dec. 5–12, 1916, July 14, 31, Aug. 6, 26, Sept. 1, 2, 12, 20–26, 1917, Apr. 14, May 6, 7, Sept. 25, 29, 30, and Oct. 2–6, 9–30, 1918; discharge corrected by comparison with flow of Skunk River at Coppock, Iowa. Gage not read, discharge interpolated, May 10, 1918. Flow probably affected by regulation at Oakland Mills, Sept. 7–11, 1919. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Skunk River at Augusta, Iowa, for the period May 27, 1915, to Sept. 30, 1920.*

[Drainage area, 4,290 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| **1915.** | | | | | |
| May 27–31 | 10,800 | 7,900 | 9,430 | 2.20 | 0.41 |
| June | 8,740 | 2,160 | 4,960 | 1.16 | 1.29 |
| July | 22,000 | 1,320 | 7,310 | 1.70 | 1.96 |
| August | 19,900 | 1,200 | 6,750 | 1.57 | 1.81 |
| September | 13,500 | 1,200 | 4,930 | 1.15 | 1.28 |
| **1915–16.** | | | | | |
| October | 10,700 | 1,790 | 5,080 | 1.18 | 1.36 |
| November | 4,820 | 1,260 | 1,940 | .452 | .50 |
| December | 2,160 | ..... | 1,070 | .249 | .29 |
| January | 18,000 | 800 | 5,410 | 1.26 | 1.45 |
| February | 10,000 | 1,000 | 3,490 | .814 | .88 |
| March | 30,800 | 1,550 | 6,760 | 1.58 | 1.82 |
| April | 5,520 | 1,430 | 2,010 | .469 | .52 |
| May | 14,100 | 1,550 | 5,370 | 1.25 | 1.44 |
| June | 17,900 | 870 | 3,440 | .802 | .89 |
| July | 1,320 | 230 | 630 | .147 | .17 |
| August | 922 | 172 | 330 | .077 | .09 |
| September | 6,780 | 150 | 742 | .173 | .19 |
| The year | 30,800 | 150 | 3,030 | .706 | 9.60 |
| **1916–17.** | | | | | |
| October | 1,030 | 57 | 252 | .059 | .07 |
| November | 818 | 138 | 338 | .079 | .09 |
| December | 468 | ..... | 193 | .045 | .05 |
| January | 1,000 | ..... | 248 | .058 | .07 |
| February | ..... | ..... | 168 | .039 | .04 |
| March | 12,100 | 150 | 3,070 | .716 | .83 |
| April | 4,390 | 922 | 1,670 | .389 | .43 |
| May | 13,700 | 1,030 | 4,540 | 1.06 | 1.22 |
| June | 27,000 | 2,280 | 12,000 | 2.80 | 3.12 |
| July | 1,910 | 500 | 965 | .225 | .26 |
| August | 975 | 172 | 388 | .090 | .10 |
| September | 2,670 | 162 | 548 | .128 | .14 |
| The year | 27,000 | 57 | 2,030 | .473 | 6.42 |
| **1917–18.** | | | | | |
| October | 210 | 80 | 139 | .032 | .04 |
| November | 190 | 113 | 144 | .034 | .04 |
| December | 190 | 60 | 103 | .024 | .03 |
| January | ..... | ..... | 50 | .012 | .01 |
| February | 4,560 | ..... | 1,340 | .312 | .32 |
| March | 2,670 | 407 | 877 | .204 | .24 |
| April | 715 | 325 | 450 | .105 | .12 |
| May | 14,100 | 300 | 2,630 | .613 | .71 |
| June | 25,600 | 1,670 | 8,640 | 2.01 | 2.24 |
| July | 3,240 | 435 | 1,420 | .331 | .38 |
| August | 2,040 | 252 | 830 | .193 | .22 |
| September | 3,400 | 210 | 696 | .162 | .18 |
| The year | 25,600 | ..... | 1,430 | 333 | 4.53 |
| **1918–19.** | | | | | |
| October | 252 | 150 | 182 | .042 | .05 |
| November | 380 | 190 | 282 | .066 | .07 |
| December | 538 | 300 | 409 | .095 | .11 |
| January | 1,670 | 150 | 505 | .118 | .14 |
| February | 1,670 | 352 | 950 | .221 | .23 |
| March | 20,400 | 715 | 5,000 | 1.17 | 1.35 |
| April | 6,360 | 1,670 | 3,770 | .879 | .98 |
| May | 21,400 | 1,430 | 6,400 | 1.49 | 1.72 |
| June | 10,100 | 1,430 | 4,440 | 1.03 | 1.15 |
| July | 2,540 | 435 | 873 | .203 | .23 |
| August | 2,800 | 190 | 584 | .136 | .16 |
| September | 2,160 | 27 | 453 | .106 | .12 |
| The year | 21,400 | 27 | 1,990 | .464 | 6.31 |

*Monthly discharge of Skunk River at Augusta, Iowa, for the period of May 27, 1915, to Sept. 30, 1920*—Continued.

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1919-20. | | | | | |
| October | 4,680 | 1,030 | 2,720 | 0.634 | 0.73 |
| November | 8,460 | 1,550 | 4,150 | .967 | 1.08 |
| December | 2,300 | 750 | 1,250 | .291 | .34 |
| January | 750 | 480 | 623 | .145 | .17 |
| February | 2,500 | 500 | 936 | .218 | .24 |
| March | 24,300 | 430 | 7,710 | 1.80 | 2.08 |
| April | 24,300 | 2,940 | 7,230 | 1.69 | 1.89 |
| May | 17,700 | 1,910 | 5,840 | 1.36 | 1.57 |
| June | 3,240 | 575 | 1,360 | .317 | .35 |
| July | 3,550 | 468 | 1,440 | .336 | .39 |
| August | 1,370 | 244 | 399 | .093 | .11 |
| September | 1,910 | 244 | 670 | .156 | .17 |
| The year | 24,300 | 244 | 2,870 | .669 | 9.12 |

### SQUAW CREEK AT AMES, IOWA.

LOCATION.—In sec. 3, T. 83 N., R. 24 W., at footbridge 1,700 feet above Chicago & Northwestern Railway bridge in Ames, Story County, and 2 miles above junction with Skunk River.

DRAINAGE AREA.—210 square miles (measured on topographic map and United States post-route map).

RECORDS AVAILABLE.—May 24, 1919, to September 30, 1920.

GAGE.—Vertical staff gage attached to middle pile of left bent of bridge; read by E. D. Burchard.

DISCHARGE MEASUREMENTS.—Made from Chicago & Northwestern Railroad bridge at extreme high stages; at other stages from footbridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; sand shifts during high water. Left bank high; right bank subject to overflow at stages above 7 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period May 27, 1919, to September 30, 1920, 8.51 feet at 7.20 p. m. October 4, 1919 (discharge, 2,210 second-feet); minimum discharge, no flow, August 28 to September 17, 1919.

Maximum stage in recent years, about 14.5 feet June 4, 1918 (discharge, about 6,900 second-feet). The creek is dry for a short period nearly every summer.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed below gage height 2.9 feet (discharge, 230 second-feet) by ice jam of March, 1920; seriously affected by ice. Two well defined rating curves used, one applicable May 27, 1919, to March 12, 1920, and the other, a revision of the former curve, applicable March 13 to September 30, 1920. Gage read to hundredths twice daily, or oftener during high water. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records excellent; winter records good.

*Discharge measurements of Squaw Creek at Ames, Iowa, during the years ending Sept. 30, 1918–1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| 1918. | *Feet.* | *Sec.-ft.* |
| June 4 *a* | 12.90 | 5,470 |
| 1919. | | |
| Apr. 30 | 4.19 | 506 |
| May 24 | 1.78 | 58.8 |
| June 3 | 4.05 | 463 |
| 10 | 2.78 | 210 |
| July 9 | 1.40 | 22.5 |
| 16 | 1.20 | 8.3 |
| 28 | 1.00 | .6 |
| Aug. 10 | .91 | .05 |
| 13 | 2.26 | 118 |
| Sept. 19 | 3.08 | 267 |
| 30 | 6.19 | 1,120 |
| 30 | 6.54 | 1,220 |
| 30 | 7.17 | 1,470 |
| 1919. | *Feet.* | *Sec.-ft.* |
| Oct. 5 | 7.10 | 1,420 |
| 27 | 1.74 | 61 |
| Nov. 10 | 8.29 | 2,070 |
| 10 | 8.45 | 2,170 |
| Dec. 2 *b* | 2.55 | 95 |
| 11 *b* | 2.44 | 83 |
| 17 *b* | 2.35 | 70 |
| 23 *b* | 2.45 | 70 |
| 31 *b* | 2.55 | 91 |
| 1920. | | |
| Jan. 8 *b* | 2.37 | 46.7 |
| 17 *b* | 2.26 | 37.3 |
| 23 *b* | 2.15 | 27.6 |
| 31 *b* | 2.28 | 24.4 |
| Feb. 7 *b* | 2.43 | 27.2 |
| 1920. | *Feet.* | *Sec.-ft.* |
| Feb. 14 *b* | 2.35 | 32.3 |
| 21 *b* | 2.22 | 23.1 |
| 28 *b* | 2.28 | 22.0 |
| Mar. 4 *c* | 6.82 | 431 |
| 6 *b* | 4.38 | 130 |
| 11 | 8.25 | 1,020 |
| 15 | 3.85 | 420 |
| 19 | 2.61 | 168 |
| Apr. 20 | 4.15 | 508 |
| May 8 | 2.17 | 115 |
| 18 | 3.25 | 303 |
| June 5 | 1.77 | 66 |
| 19 | 1.29 | 24.1 |
| July 4 | 4.90 | 688 |
| 31 | 1.00 | 6.6 |

*a* Measurement made by R. W. Clyde at Chicago & Northwestern Railroad bridge a quarter of a mile below gage. Stage referred to a reference point which was later referred to gage datum.
*b* Measurement made through ice.
*c* Stage-discharge relation affected by an ice jam.

*Daily discharge, in second-feet, of Squaw Creek at Ames, Iowa, for the period May 24, 1919, to Sept. 30, 1920.*

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919. | | | | | | 1919. | | | | | |
| 1 | | 104 | 30 | 0.5 | 0 | 16 | | 134 | 8.5 | 5.8 | 0 |
| 2 | | 709 | 26 | .5 | 0 | 17 | | 118 | 6.7 | 2.6 | 0 |
| 3 | | 602 | 22 | .5 | 0 | 18 | | 193 | 6.2 | 1.6 | 9.0 |
| 4 | | 921 | 22 | .5 | 0 | 19 | | 90 | 4.9 | .6 | 193 |
| 5 | | 1,200 | 18 | .4 | 0 | 20 | | 83 | 4.9 | .5 | 50 |
| 6 | | 826 | 16 | .6 | 0 | 21 | | 78 | 4.0 | .4 | 34 |
| 7 | | 436 | 12 | 1.3 | 0 | 22 | | 72 | 3.3 | .4 | 20 |
| 8 | | 329 | 5.8 | .5 | 0 | 23 | | 70 | 3.3 | .3 | 13 |
| 9 | | 249 | 34 | .4 | 0 | 24 | 68 | 64 | 2.3 | .2 | 11 |
| 10 | | 211 | 16 | .1 | 0 | 25 | 66 | 54 | 2.3 | .1 | 7.6 |
| 11 | | 230 | 11 | .4 | 0 | 26 | 66 | 47 | 1.3 | 0 | 6.7 |
| 12 | | 220 | 12 | 2.0 | 0 | 27 | 54 | 41 | .6 | 0 | 5.4 |
| 13 | | 175 | 14 | 97 | 0 | 28 | 54 | 37 | .6 | 0 | 6.2 |
| 14 | | 158 | 15 | 24 | 0 | 29 | 49 | 34 | .5 | 0 | 20 |
| 15 | | 142 | 12 | 10 | 0 | 30 | 44 | 30 | .4 | 0 | 1,130 |
| | | | | | | 31 | 44 | | .5 | 0 | |

*Daily discharge, in second-feet, of Squaw Creek at Ames, Iowa, for the period May 24, 1919, to Sept. 30, 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 954 | 134 | 100 | 60 | 24 | 11 | 392 | 329 | 90 | 78 | 6.0 | 6.3 |
| 2 | 329 | 111 | 95 | 60 | 24 | 44 | 371 | 249 | 80 | 80 | 5.4 | 6.6 |
| 3 | 371 | 104 | 95 | 60 | 24 | 220 | 230 | 195 | 70 | 73 | 4.7 | 27 |
| 4 | 1,670 | 84 | 95 | 50 | 24 | 340 | 170 | 162 | 66 | 46 | 4.1 | 58 |
| 5 | 1,240 | 74 | 90 | 48 | 24 | 160 | 110 | 146 | 64 | 504 | 3.8 | 63 |
| 6 | 481 | 69 | 85 | 48 | 26 | 130 | 138 | 131 | 57 | 392 | 3.4 | 47 |
| 7 | 308 | 64 | 80 | 46 | 28 | 95 | 117 | 117 | 63 | 230 | 3.0 | 31 |
| 8 | 230 | 61 | 75 | 46 | 30 | 46 | 117 | 110 | 57 | 186 | 2.9 | 37 |
| 9 | 240 | 202 | 60 | 42 | 36 | 340 | 110 | 104 | 51 | 131 | 4.1 | 1,020 |
| 10 | 193 | 1,720 | 65 | 40 | 46 | 700 | 104 | 92 | 49 | 110 | 4.7 | 987 |
| 11 | 166 | 1,280 | 85 | 40 | 50 | 950 | 98 | 104 | 42 | 86 | 4.7 | 436 |
| 12 | 134 | 766 | 80 | 40 | 38 | 900 | 110 | 987 | 36 | 98 | 104 | 249 |
| 13 | 127 | 371 | 75 | 40 | 55 | 550 | 104 | 1,570 | 33 | 82 | 37 | 170 |
| 14 | 120 | 268 | 65 | 40 | 34 | 414 | 98 | 709 | 33 | 70 | 18 | 131 |
| 15 | 112 | 230 | 65 | 42 | 36 | 329 | 92 | 414 | 33 | 65 | 11 | 104 |
| 16 | 104 | 202 | 70 | 42 | 28 | 154 | 92 | 350 | 31 | 54 | 8.2 | 85 |
| 17 | 97 | 202 | 75 | 36 | 34 | 162 | 80 | 329 | 29 | 46 | 7.1 | 74 |
| 18 | 90 | 202 | 70 | 34 | 30 | 178 | 80 | 288 | 25 | 38 | 6.6 | 68 |
| 19 | 84 | 193 | 70 | 34 | 26 | 162 | 212 | 268 | 24 | 31 | 9.3 | 54 |
| 20 | 78 | 175 | 70 | 32 | 22 | 178 | 458 | 230 | 23 | 27 | 20 | 48 |
| 21 | 71 | 175 | 65 | 28 | 24 | 146 | 308 | 204 | 24 | 28 | 240 | 43 |
| 22 | 66 | 175 | 75 | 28 | 24 | 146 | 249 | 178 | 23 | 23 | 78 | 37 |
| 23 | 58 | 166 | 70 | 28 | 26 | 186 | 230 | 170 | 22 | 19 | 48 | 36 |
| 24 | 56 | 150 | 70 | 26 | 28 | 178 | 186 | 162 | 21 | 17 | 31 | 33 |
| 25 | 61 | 142 | 70 | 30 | 28 | 212 | 162 | 146 | 20 | 14 | 23 | 29 |
| 26 | 57 | 104 | 75 | 32 | 11 | 602 | 186 | 124 | 19 | 13 | 16 | 27 |
| 27 | 53 | 72 | 80 | 30 | 16 | 371 | 268 | 110 | 21 | 12 | 13 | 21 |
| 28 | 49 | 72 | 80 | 30 | 22 | 288 | 240 | 110 | 26 | 11 | 11 | 19 |
| 29 | 46 | 78 | 85 | 28 | 7 | 230 | 195 | 98 | 31 | 9.3 | 8.8 | 18 |
| 30 | 118 | 78 | 90 | 26 | ..... | 212 | 371 | 92 | 29 | 7.1 | 10 | 18 |
| 31 | 184 | ..... | 90 | 24 | ..... | 178 | ..... | 88 | ..... | 6.3 | 7.1 | ..... |

NOTE.—Stage-discharge relation affected by ice Nov. 28, 1919, to Mar. 13, 1920; discharge ascertained by means of gage heights, 15 discharge measurements, observer's notes, and weather records. Gage not read, discharge interpolated, Oct. 13–16, 18–20, 26, Nov. 6, 1919, June 2, 22, 23, 25, 28, and Sept. 6, 1920. Gage not read, discharge estimated, June 4–7, 1919. Stream practically dry Aug. 26 to Sept. 17, 1919.

*Monthly discharge of Squaw Creek at Ames, Iowa, for the period May 24, 1919, to Sept. 30, 1920.*

[Drainage area, 210 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1919. | | | | | |
| May 24–31 | 68 | 44 | 55.6 | 0.265 | 0.08 |
| June | 1,200 | 30 | 255 | 1.21 | 1.35 |
| July | 34 | .4 | 10.2 | .049 | .06 |
| August | 97 | 0 | 4.88 | .023 | .03 |
| September | 1,130 | 0 | 50.2 | .239 | .27 |
| 1919–20. | | | | | |
| October | 1,670 | 46 | 256 | 1.22 | 1.41 |
| November | 1,720 | 61 | 257 | 1.22 | 1.36 |
| December | 100 | 60 | 77.9 | .371 | .43 |
| January | 60 | 24 | 38.4 | .183 | .21 |
| February | 55 | 7 | 28.4 | .135 | .15 |
| March | 950 | 46 | 284 | 1.35 | 1.56 |
| April | 458 | 80 | 189 | .900 | 1.00 |
| May | 1,570 | 88 | 270 | 1.29 | 1.49 |
| June | 90 | 19 | 39.7 | .189 | .21 |
| July | 504 | 6.3 | 83.4 | .397 | .46 |
| August | 240 | 2.9 | 24.3 | .116 | .13 |
| September | 1,020 | 6.3 | 133 | .633 | .71 |
| The year | 1,720 | 2.9 | 141 | .671 | 9.12 |

### DES MOINES RIVER AT KALO, IOWA.

LOCATION.—In sec. 17, T. 88 N., R. 28 W., at highway bridge in Kalo, Webster County, 1½ miles east of Otho, a station on Minneapolis & St. Louis Railroad, and 1½ miles above mouth of Holiday Creek, which enters from left.

DRAINAGE AREA.—4,170 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 18, 1913, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge in middle of right span; read by S. C. Fuller.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Control not well defined. Bed composed of gravel; practically permanent. Point of zero flow estimated to be at gage height −1.0 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 9.1 feet June 24 and 25 (discharge, 10,200 second-feet); minimum stage, 0.70 foot at 6.30 p. m. September 5 (discharge, 196 second-feet).

Maximum stage recorded during year ending September 30, 1920, 11.38 feet at 8.20 p. m. July 9 (discharge, 14,200 second-feet); minimum discharge, estimated 28 second-feet January 22 (stage-discharge relation affected by ice).

1913–1920: Maximum stage recorded, 14.0 feet May 30, 1915 (discharge, 18,500 (second-feet); minimum discharge, estimated 28 second-feet January 22, 1920 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of city power plant, at Fort Dodge, about 7 miles upstream, causes diurnal fluctuation during low water.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined above 1,000 second-feet; below 1,000 second-feet rating is uncertain at times on account of shifting control. Gage read to hundredths once daily except during winter, when it is read irregularly or not at all. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records excellent except for periods of low water, for which they are poor on account of diurnal fluctuation; winter records fair.

*Discharge measurements of Des Moines River at Kalo, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Oct. 17 | H. C. Beckman | 0.80 | 247 | Dec. 16 [a] | E. D. Burchard | 0.97 | 60 |
| 1919. | | | | 1920. | | | |
| Mar. 27 | E. D. Burchard | 6.10 | 5,200 | Jan. 8 [a] | do | 1.61 | 151 |
| Aug. 19 | do | 1.56 | 660 | Feb. 18 [a] | do | 1.59 | 95 |
| Sept. 5 | do | .89 | 291 | Mar. 29 | do | 4.83 | 3,810 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1918–19.** | | | | | | | | | | | | |
| 1 | 236 | 2,000 | 1,010 | ..... | 970 | ..... | 4,650 | 5,210 | 905 | 5,500 | 1,110 | 271 |
| 2 | 302 | 2,000 | 1,110 | ..... | ..... | ..... | 4,370 | 5,350 | 2,410 | 5,070 | 1,040 | 216 |
| 3 | 280 | 1,820 | 1,180 | ..... | ..... | ..... | 4,240 | 5,650 | 3,220 | 4,650 | 1,040 | 325 |
| 4 | 236 | 1,640 | 1,250 | ..... | ..... | ..... | 4,110 | 5,950 | 4,510 | 4,240 | 1,040 | 348 |
| 5 | 258 | 1,640 | 1,180 | ..... | ..... | ..... | 4,240 | 6,550 | 4,510 | 3,980 | 905 | 196 |
| 6 | 258 | 1,480 | 1,110 | ..... | ..... | ..... | 4,110 | 7,010 | 4,650 | 4,040 | 840 | 325 |
| 7 | 245 | 1,320 | 1,110 | ..... | ..... | ..... | 4,240 | 6,700 | 4,650 | 4,110 | 905 | 325 |
| 8 | 370 | 1,180 | 1,220 | ..... | ..... | ..... | 4,650 | 6,850 | 4,510 | 4,510 | 840 | 325 |
| 9 | 325 | 1,250 | 1,320 | ..... | ..... | ..... | 5,500 | 6,700 | 4,370 | 4,650 | 905 | 280 |
| 10 | 470 | 1,250 | 1,320 | ..... | ..... | ..... | 5,800 | 6,100 | 4,370 | 4,510 | 840 | 280 |
| 11 | 325 | 1,250 | 1,480 | ..... | ..... | ..... | 6,100 | 5,720 | 4,930 | 3,720 | 742 | 280 |
| 12 | 271 | 1,480 | 1,400 | ..... | ..... | ..... | 6,700 | 5,350 | 5,210 | 3,340 | 678 | 316 |
| 13 | 236 | 1,400 | 1,910 | ..... | ..... | 2,520 | 6,850 | 4,930 | 5,800 | 3,340 | 742 | 420 |
| 14 | 236 | 1,320 | 2,000 | ..... | ..... | 2,630 | 7,490 | 4,510 | 5,650 | 2,860 | 710 | 325 |
| 15 | 302 | 1,320 | 2,000 | ..... | ..... | 3,590 | 7,650 | 4,110 | 5,650 | 2,630 | 775 | 370 |
| 16 | 236 | 1,320 | 2,100 | ..... | ..... | 6,400 | 7,970 | 3,850 | 6,100 | 2,410 | 840 | 395 |
| 17 | 245 | 1,320 | 2,100 | ..... | ..... | 7,330 | 8,630 | 3,460 | 6,700 | 2,520 | 840 | 370 |
| 18 | 325 | 1,320 | 2,000 | ..... | ..... | 7,330 | 8,630 | 3,220 | 7,650 | 2,630 | 775 | 395 |
| 19 | 236 | 1,480 | 1,820 | ..... | ..... | 7,330 | 8,630 | 3,100 | 7,170 | 2,410 | 710 | 348 |
| 20 | 258 | 1,640 | 1,820 | ..... | ..... | 7,330 | 8,460 | 3,100 | 8,800 | 2,100 | 678 | 316 |
| 21 | 280 | 1,640 | 1,820 | ..... | ..... | 6,550 | 7,970 | 2,860 | 8,800 | 2,100 | 645 | 280 |
| 22 | 236 | 1,640 | 1,910 | ..... | ..... | 5,800 | 7,650 | 2,860 | 8,720 | 1,910 | 615 | 370 |
| 23 | 236 | 1,640 | 1,730 | ..... | ..... | 5,950 | 7,970 | 2,520 | 8,630 | 1,730 | 555 | 325 |
| 24 | 280 | 1,520 | 1,820 | ..... | ..... | 5,210 | 7,650 | 2,410 | 10,200 | 1,640 | 525 | 302 |
| 25 | 325 | 1,400 | 1,480 | ..... | ..... | 5,350 | 7,010 | 2,200 | 10,200 | 1,560 | 498 | 325 |
| 26 | 348 | 1,320 | 1,180 | ..... | ..... | 5,500 | 5,210 | 2,200 | 9,650 | 1,320 | 348 | 236 |
| 27 | 420 | 1,110 | 970 | ..... | ..... | 5,500 | 5,500 | 2,060 | 9,140 | 1,320 | 526 | 204 |
| 28 | 525 | 1,250 | 905 | ..... | ..... | 5,350 | 5,800 | 1,910 | 8,290 | 1,250 | 445 | 246 |
| 29 | 1,180 | 1,110 | 970 | ..... | ..... | 5,210 | 5,500 | 1,820 | 6,700 | 1,110 | 348 | 289 |
| 30 | 1,820 | 905 | 1,040 | ..... | ..... | 4,930 | 5,500 | 905 | 6,250 | 1,040 | 316 | 302 |
| 31 | 2,000 | ..... | 1,320 | ..... | ..... | 4,790 | ..... | 905 | ..... | 1,040 | 280 | ..... |
| **1919–20.** | | | | | | | | | | | | |
| 1 | 325 | 236 | 100 | 75 | 75 | 55 | 3,160 | 3,980 | 2,300 | 2,740 | 1,780 | 2,100 |
| 2 | 280 | 258 | 100 | 75 | 75 | 100 | 3,100 | 4,240 | 2,200 | 5,070 | 1,730 | 1,480 |
| 3 | 325 | 196 | 130 | 200 | 65 | 200 | 2,980 | 4,510 | 2,410 | 5,070 | 1,640 | 1,640 |
| 4 | 370 | 128 | 130 | 220 | 55 | 200 | 2,860 | 4,110 | 2,300 | 4,660 | 1,560 | 1,640 |
| 5 | 325 | 245 | 160 | 260 | 75 | 160 | 2,740 | 3,850 | 2,000 | 4,240 | 2,100 | 1,920 |
| 6 | 370 | 178 | 160 | 400 | 100 | 130 | 2,630 | 3,590 | 1,860 | 9,480 | 3,460 | 2,200 |
| 7 | 258 | 128 | 130 | 90 | 95 | 100 | 2,300 | 3,220 | 1,730 | 13,700 | 3,100 | 2,200 |
| 8 | 280 | 178 | 100 | 150 | 100 | 100 | 2,200 | 2,980 | 1,640 | 13,700 | 2,300 | 2,000 |
| 9 | 325 | 280 | 75 | 75 | 100 | 240 | 2,100 | 2,860 | 1,480 | 13,000 | 1,910 | 2,630 |
| 10 | 325 | 498 | 75 | 110 | 90 | 2,600 | 2,200 | 2,740 | 1,320 | 13,200 | 1,640 | 2,200 |
| 11 | 348 | 678 | 75 | 140 | 100 | 7,000 | 2,250 | 2,630 | 1,110 | 12,300 | 1,480 | 2,630 |
| 12 | 258 | 645 | 100 | 140 | 75 | 8,500 | 2,300 | 3,590 | 1,180 | 10,700 | 1,320 | 2,320 |
| 13 | 258 | 645 | 100 | 110 | 90 | 9,000 | 2,300 | 3,850 | 1,140 | 9,480 | 1,180 | 2,000 |
| 14 | 280 | 498 | 100 | 80 | 75 | 9,000 | 2,410 | 4,930 | 1,110 | 9,310 | 1,180 | 2,200 |
| 15 | 258 | 325 | 75 | 70 | 75 | 8,500 | 2,740 | 5,070 | 1,400 | 8,800 | 1,140 | 1,820 |
| 16 | 280 | 325 | 60 | 75 | 100 | 8,290 | 2,410 | 5,210 | 1,320 | 8,130 | 1,110 | 1,820 |
| 17 | 154 | 348 | 110 | 55 | 100 | 8,130 | 2,000 | 5,350 | 2,000 | 7,170 | 970 | 1,320 |
| 18 | 258 | 555 | 280 | 55 | 95 | 7,650 | 2,260 | 5,210 | 2,000 | 6,550 | 905 | 1,180 |
| 19 | 325 | 445 | 130 | 55 | 90 | 7,170 | 2,520 | 4,790 | 1,910 | 6,100 | 970 | 910 |
| 20 | 280 | 585 | 55 | 40 | 100 | 5,950 | 3,980 | 4,370 | 2,000 | 5,500 | 2,980 | 645 |
| 21 | 134 | 525 | 95 | 38 | 100 | 4,650 | 4,650 | 4,110 | 2,100 | 5,500 | 4,980 | 645 |
| 22 | 271 | 555 | 130 | 28 | 90 | 4,240 | 3,850 | 3,980 | 2,200 | 4,930 | 3,460 | 775 |
| 23 | 236 | 525 | 110 | 36 | 75 | 3,850 | 3,720 | 3,850 | 2,200 | 4,370 | 2,520 | 645 |
| 24 | 236 | 498 | 110 | 75 | 75 | 3,850 | 3,220 | 3,720 | 2,000 | 4,110 | 1,910 | 1,040 |
| 25 | 258 | 555 | 130 | 110 | 90 | 3,980 | 3,040 | 3,340 | 1,910 | 3,480 | 1,730 | 1,040 |
| 26 | 236 | 470 | 100 | 110 | 75 | 4,240 | 2,860 | 3,340 | 1,730 | 2,860 | 1,480 | 1,110 |
| 27 | 280 | 100 | 100 | 110 | 65 | 4,370 | 2,980 | 3,220 | 1,640 | 2,630 | 1,110 | 1,180 |
| 28 | 258 | 160 | 200 | 80 | 55 | 3,980 | 3,460 | 2,980 | 1,560 | 2,410 | 1,040 | 1,040 |
| 29 | 271 | 160 | 300 | 80 | 50 | 3,720 | 3,460 | 2,630 | 2,100 | 2,200 | 1,040 | 1,040 |
| 30 | 302 | 130 | 160 | 100 | ..... | 3,460 | 3,590 | 2,580 | 2,200 | 2,100 | 1,040 | 905 |
| 31 | 245 | ..... | 100 | 100 | ..... | 3,220 | ..... | 2,520 | ..... | 1,820 | 2,740 | ..... |

NOTE.—Gage readings discontinued because of ice Jan. 1 to Mar. 12, 1919. During that period observer noted that river was free of ice three times. Stage-discharge relation affected by ice Nov. 27, 1919, to Mar. 15, 1920; discharge ascertained by means of gage heights, discharge measurements, observer's notes, and weather records. Gage not read, discharge interpolated Oct. 20, Nov. 10, 17, 24, Dec. 1, 8, 1918, Apr. 27, May 11, June 8, 22, July 6, Sept. 28, 1919; Apr. 4, 11, 18, 25, May 2, 9, 16, 23, 30, June 6, 13, 20, 27, July 4, 25, Aug. 1, 15, 29, and Sept. 5, 12, 19, 26, 1920. During winter, diurnal fluctuation below stage 1.2 feet (discharge, 420 second-feet), may introduce an error of 25 per cent in any one determination of daily discharge.

*Monthly discharge of Des Moines River at Kalo, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 4,170 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,000 | 236 | 429 | 0.103 | 0.12 |
| November | 2,000 | 905 | 1,430 | .343 | .38 |
| December | 2,000 | 905 | 1,470 | .353 | .41 |
| March 13–31 | 7,330 | 2,520 | 5,510 | 1.32 | .93 |
| April | 8,680 | 4,110 | 6,290 | 1.51 | 1.68 |
| May | 7,010 | 905 | 4,060 | .974 | 1.12 |
| June | 10,200 | 905 | 6,280 | 1.51 | 1.68 |
| July | 5,500 | 1,040 | 2,880 | .691 | .80 |
| August | 1,110 | 280 | 711 | .171 | .20 |
| September | 420 | 196 | 310 | .074 | .08 |
| 1919–20. | | | | | |
| October | 370 | 134 | 278 | .067 | .08 |
| November | 678 | 100 | 368 | .088 | .10 |
| December | 300 | 55 | 122 | .029 | .03 |
| January | 400 | 28 | 108 | .026 | .03 |
| February | 100 | 50 | 82.9 | .020 | .02 |
| March | 9,000 | 55 | 4,080 | .978 | 1.13 |
| April | 4,650 | 2,000 | 2,870 | .688 | .77 |
| May | 5,350 | 2,520 | 3,790 | .909 | 1.05 |
| June | 2,410 | 1,110 | 1,800 | .432 | .48 |
| July | 13,700 | 1,820 | 6,620 | 1.59 | 1.83 |
| August | 4,930 | 905 | 1,850 | .444 | .51 |
| September | 2,630 | 645 | 1,540 | .369 | .41 |
| The year | 13,700 | 28 | 1,970 | .472 | 6.44 |

### DES MOINES RIVER NEAR BOONE, IOWA.

LOCATION.—In sec. 12, T. 84 N., R. 27 W., at highway bridge in Centerville, 2½ miles northwest of Boone, Boone County, 1 mile above Boone waterworks, and 3 miles above Bluff Creek, which enters from right.

DRAINAGE AREA.—5,480 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 1 to September 30, 1920. Scattered records of stage were obtained by United States Weather Bureau at gage 3½ miles downstream at Chicago & Northwestern Railroad crossing, during period 1905 to 1917.

GAGE.—Chain gage attached to downstream side of bridge, 20 feet from left end of right span; read by S. A. Elliott.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; practically permanent. Control is remains of old dam, 300 feet below bridge; well defined and probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 13.39 feet at 6.30 a. m. July 11 (discharge, 16,900 second-feet); minimum stage, 2.95 feet at 11 a. m. September 30 (discharge, 1,240 second-feet).

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

REGULATION.—The city power plant at Fort Dodge about 40 miles upstream, causes some diurnal fluctuation during extremely low water.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve well defined between 800 and 18,000 second-feet. Gage read to hundredths once daily, or oftener during days of rapidly changing stage. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to table of daily discharge. Records excellent.

*Discharge measurements of Des Moines River near Boone, Iowa, during the year ending Sept. 30, 1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Apr. 6 | 4.48 | 3,440 | Apr. 30 | 5.66 | 5,190 | July 6 | 7.96 | 8,270 |
| 9 | 4.01 | 2,790 | May 13 | 6.13 | 5,970 | 10 | 13.14 | 16,500 |
| 20 | 5.80 | 5,390 | July 3 | 7.11 | 7,120 | Sept. 3 | 3.55 | 2,100 |

*Daily discharge, in second-feet, of Des Moines River near Boone, Iowa, for the period Apr. 1 to Sept. 30, 1920.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4,200 | 5,360 | 3,320 | 3,040 | 2,460 | 3,320 | 16 | 3,040 | 7,240 | 1,580 | 11,400 | 1,380 | 2,740 |
| 2 | 4,200 | 5,940 | 3,040 | 4,200 | 2,160 | 3,180 | 17 | 2,740 | 7,240 | 1,880 | 10,300 | 1,380 | 2,460 |
| 3 | 4,000 | 6,220 | 3,040 | 6,660 | 2,160 | 2,740 | 18 | 2,740 | 7,100 | 2,600 | 8,840 | 1,380 | 2,160 |
| 4 | 3,600 | 5,790 | 3,320 | 7,380 | 1,730 | 2,460 | 19 | 2,740 | 6,660 | 2,740 | 8,110 | 1,440 | 1,880 |
| 5 | 3,500 | 4,920 | 3,180 | 7,530 | 1,660 | 2,160 | 20 | 5,360 | 6,220 | 2,890 | 7,530 | 1,520 | 1,880 |
| 6 | 3,470 | 4,920 | 2,740 | 7,240 | 3,320 | 3,040 | 21 | 6,660 | 6,080 | 2,740 | 6,800 | 3,040 | 1,730 |
| 7 | 3,100 | 4,630 | 2,460 | 11,900 | 4,780 | 3,180 | 22 | 6,520 | 5,790 | 2,740 | 5,360 | 6,370 | 1,730 |
| 8 | 2,900 | 4,200 | 2,310 | 15,400 | 4,200 | 3,470 | 23 | 6,080 | 5,360 | 2,740 | 5,210 | 6,080 | 1,660 |
| 9 | 2,740 | 3,900 | 2,310 | 16,600 | 3,040 | 4,050 | 24 | 5,210 | 5,210 | 2,600 | 5,060 | 5,640 | 1,580 |
| 10 | 2,740 | 3,760 | 2,160 | 16,600 | 2,460 | 5,790 | 25 | 4,480 | 5,210 | 2,460 | 4,340 | 4,920 | 1,580 |
| 11 | 2,740 | 3,620 | 1,730 | 16,900 | 1,880 | 5,790 | 26 | 4,200 | 5,060 | 2,310 | 3,900 | 3,040 | 1,580 |
| 12 | 2,740 | 3,900 | 1,660 | 14,300 | 1,880 | 5,790 | 27 | 4,480 | 4,630 | 2,310 | 3,620 | 2,460 | 1,660 |
| 13 | 2,890 | 5,210 | 1,580 | 13,500 | 1,730 | 4,340 | 28 | 4,780 | 4,480 | 2,020 | 3,320 | 2,160 | 1,520 |
| 14 | 3,040 | 6,370 | 1,240 | 13,200 | 1,580 | 4,050 | 29 | 4,920 | 3,900 | 2,160 | 3,040 | 1,730 | 1,300 |
| 15 | 3,040 | 7,100 | 1,380 | 12,300 | 1,380 | 3,470 | 30 | 5,060 | 3,620 | 2,460 | 2,740 | 1,580 | 1,240 |
| | | | | | | | 31 | ..... | 3,180 | ..... | 2,600 | 2,740 | ..... |

NOTE.—Discharge estimated Apr. 1–5, 7, and 8, owing to lack of gage readings.

*Monthly discharge of Des Moines River near Boone, Iowa, for the period Apr. 1 to Sept. 30, 1920.*

[Drainage area, 5,480 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| April | 6,660 | 2,740 | 3,930 | 0.717 | 0.80 |
| May | 7,240 | 3,180 | 5,250 | .958 | 1.10 |
| June | 3,320 | 1,240 | 2,390 | .436 | .49 |
| July | 16,900 | 2,600 | 8,350 | 1.52 | 1.75 |
| August | 6,370 | 1,380 | 2,690 | .491 | .57 |
| September | 5,790 | 1,240 | 2,780 | .507 | .57 |

### DES MOINES RIVER NEAR TRACY, IOWA.

LOCATION.—In sec. 19, T. 75 N., R. 17 W., in Mahaska County, at highway bridge in Bellefontaine, near Tracy, Marion County, 3 miles above mouth of Cedar Creek and 6 miles below mouth of English Creek, both of which enter from right.

DRAINAGE AREA.—12,400 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 1 to September 30, 1920. From about April 22 to December 31, 1910, the United States Engineer Corps obtained daily gage readings at the same site.

GAGE.—Chain gage attached to downstream side of bridge near right end of second span from right end of bridge; read by D. M. Coleman. Sea-level elevation of the zero of gage, 671.78 feet.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of solid rock overlain in places with sand and gravel; probably permanent. Right bank high; left bank subject to overflow at high stages. Low-water control well defined; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 14.74 feet at 7 p. m. May 14 (discharge, 31,900 second-feet); minimum discharge, estimated 750 second-feet March 1 (stage-discharge relation affected by ice).

Maximum stage since 1850 about 25 feet May 31, 1903 (discharge, estimated 100,000 second-feet).

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined between 1,500 and 25,000 second-feet; extended beyond these limits and subject to error. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period, March 1–13, during which stage-discharge relation was affected by ice, for which it was estimated. Open-water records excellent; winter records fair.

*Discharge measurements of Des Moines River near Tracy, Iowa, during the year ending Sept. 30, 1920.*

[Made by E. D. Burchard.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Mar. 23 | 8.02 | 10,300 | May 15 | 13.93 | 28,400 | July 12 | 11.25 | 20,200 |
| May 1 | 9.86 | 15,700 | June 28 | 4.85 | 3,600 | | | |

*Daily discharge, in second-feet, of Des Moines River near Tracy, Iowa, for the period Mar. 1 to Sept. 30, 1920.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | 750 | 11,900 | 15,700 | 6,430 | 3,510 | 4,000 | 3,350 |
| 2 | 850 | 17,300 | 15,100 | 6,220 | 4,170 | 3,830 | 3,510 |
| 3 | 1,000 | 18,200 | 14,500 | 6,220 | 5,250 | 3,510 | 4,000 |
| 4 | 4,000 | 13,000 | 12,700 | 5,820 | 6,640 | 3,200 | 4,510 |
| 5 | 9,500 | 9,730 | 12,400 | 5,630 | 8,450 | 3,050 | 6,220 |
| 6 | 6,500 | 8,450 | 11,800 | 5,630 | 9,730 | 2,900 | 7,740 |
| 7 | 5,500 | 8,210 | 10,300 | 5,440 | 13,000 | 3,510 | 6,020 |
| 8 | 4,000 | 7,970 | 9,470 | 5,250 | 18,300 | 5,510 | 4,870 |
| 9 | 4,400 | 7,970 | 8,700 | 7,290 | 15,100 | 4,870 | 9,210 |
| 10 | 4,600 | 7,070 | 8,210 | 7,970 | 18,000 | 4,510 | 13,300 |
| 11 | 5,500 | 6,430 | 7,740 | 6,850 | 19,200 | 3,670 | 11,600 |
| 12 | 6,000 | 6,020 | 18,000 | 5,820 | 19,900 | 3,350 | 8,950 |
| 13 | 12,000 | 6,640 | 25,600 | 4,690 | 20,800 | 3 200 | 7,970 |
| 14 | 18,600 | 6,850 | 31,400 | 4,510 | 24,200 | 3,050 | 7,290 |
| 15 | 23,800 | 6,640 | 27,200 | 3,830 | 27,200 | 2,620 | 6,020 |
| 16 | 24,800 | 6,640 | 19,600 | 3,510 | 21,500 | 2,480 | 5,440 |
| 17 | 20,800 | 6,430 | 16,700 | 3,200 | 17,300 | 2,480 | 4,870 |
| 18 | 19,600 | 6,020 | 16,000 | 3,350 | 14,800 | 2,350 | 4,340 |
| 19 | 18,600 | 11,100 | 14,800 | 3,510 | 12,400 | 2,220 | 3,830 |
| 20 | 16,000 | 23,800 | 13,900 | 3,830 | 11,100 | 2,220 | 3,510 |
| 21 | 14,200 | 22,500 | 12,400 | 4,170 | 10,300 | 2,220 | 3,200 |
| 22 | 12,200 | 23,100 | 11,600 | 4,340 | 10,000 | 2,480 | 2,900 |
| 23 | 10,500 | 21,800 | 11,100 | 4,340 | 8,700 | 5,830 | 2,620 |
| 24 | 10,800 | 18,000 | 10,300 | 4,170 | 7,510 | 9,210 | 2,620 |
| 25 | 15,100 | 15,100 | 10,000 | 4,510 | 7,070 | 8,210 | 2,620 |
| 26 | 25,200 | 14,200 | 10,000 | 4,170 | 6,640 | 7,290 | 2,480 |
| 27 | 27,200 | 18,000 | 8,950 | 3,670 | 6,220 | 6,220 | 2,350 |
| 28 | 25,200 | 18,600 | 8,210 | 3,670 | 5,630 | 5,250 | 2,350 |
| 29 | 18,900 | 15,400 | 7,740 | 3,510 | 5,060 | 4,510 | 2,350 |
| 30 | 14,500 | 14,800 | 7,290 | 3,510 | 4,690 | 4,170 | 2,350 |
| 31 | 11,900 | ..... | 6,850 | ..... | 4,340 | 3,830 | ..... |

*Monthly discharge of Des Moines River near Tracy, Iowa, for the period Mar. 1 to Sept. 30, 1920.*

[Drainage area, 12,400 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| March | 27,200 | 750 | 12,700 | 1.02 | 1.18 |
| April | 23,800 | 6,020 | 12,600 | 1.01 | 1.13 |
| May | 31,400 | 6,850 | 13,500 | 1.09 | 1.26 |
| June | 7,970 | 3,200 | 4,840 | .390 | .44 |
| July | 27,200 | 3,510 | 11,700 | .944 | 1.09 |
| August | 9,210 | 2,220 | 3,990 | .322 | .37 |
| September | 13,300 | 2,350 | 5,080 | .410 | .46 |

### DES MOINES RIVER AT OTTUMWA, IOWA.

LOCATION.—At Market Street bridge, Ottumwa, Wapello County. No large tributary within several miles up or down stream.

DRAINAGE AREA.—13,200 square miles (measured on map issued by United States Geological Survey; scale 1 to 500,000).

RECORDS AVAILABLE.—March 28, 1917, to September 30, 1920. Fragmentary high-water observations were obtained 1902 to 1916.

GAGE.—Chain gage attached to downstream handrail of bridge; read by Henry Eilers. Staff gage painted on northeast face of north pier used prior to August 2, 1917.

DISCHARGE MEASUREMENTS.—Made from Vine Street bridge about 1,500 feet below gage or by wading.

CHANNEL AND CONTROL.—Channel forms control; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 14.2 feet May 7 (discharge, 43,200 second-feet); minimum stage, 1.40 feet October 9 and 10 and September 15–18 (discharge, 525 second-feet).

Maximum stage recorded during year ending September 30, 1920, 12.3 feet March 26 (discharge, 34,700 second-feet); minimum stage, 2.2 feet October 30 (discharge, 1,460 second-feet); minimum flow probably occurred during winter.

1917–1920: Maximum stage recorded, 16.5 feet June 11, 1917 (discharge, 58,700 second-feet); minimum stage, 1.2 feet, to surface of ice, on several days during December 1917 (discharge, estimated somewhat less than 350 second-feet).

Maximum discharge since 1850 and probably in the last century occurred May 31, 1903, and exceeded 100,000 second-feet.

ICE.—Stage-discharge relation affected by ice during extremely cold weather; observations are discontinued when serious ice conditions prevail.

REGULATION.—Operation of power plant a short distance above gage probably causes some diurnal fluctuation at low stages.

ACCURACY.—Stage-discharge relation changed during break-up of ice in March, 1920; slightly affected by ice in 1919, and seriously affected by ice in 1920. Two fairly well defined rating curves used, applicable respectively, October 1, 1918, to December 2, 1919, and March 13 to September 30, 1920. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Des Moines River at Ottumwa, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 24 | H. C. Beckman | 1.49 | 615 | May 5 | E. D. Burchard | 11.29 | 31,900 |
| 1919. | | | | Aug. 11 | do | 3.59 | 4,960 |
| June 6 | E. D. Burchard | 12.00 | 32,900 | | | | |
| Sept. 14 | do | 1.53 | 778 | | | | |

*Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 845 | 2,060 | 1,900 | 1,750 | 2,560 | 2,740 | 8,990 | 17,100 | 4,390 | 14,200 | 3,120 | 960 |
| 2 | 845 | 2,060 | 2,220 | | 2,220 | | 8,450 | 18,800 | 11,200 | 11,800 | 3,120 | 960 |
| 3 | 735 | 2,740 | 2,060 | | 2,220 | | 8,180 | 20,200 | 21,600 | 10,100 | 3,120 | 735 |
| 4 | 735 | 3,120 | 1,900 | | 2,060 | | 7,910 | 29,100 | 25,400 | 8,990 | 2,740 | 960 |
| 5 | 735 | 2,930 | 1,900 | | 2,060 | | 7,640 | 34,800 | 28,700 | 10,700 | 2,740 | 960 |
| | | | | | | 2,450 | | | | | | |
| 6 | 735 | 2,930 | 2,060 | | 2,060 | | 7,120 | 36,900 | 30,400 | 8,450 | 2,390 | 960 |
| 7 | 735 | 2,740 | 2,220 | | 2,060 | | 6,600 | 43,200 | 35,300 | 7,380 | 4,390 | 960 |
| 8 | 625 | 2,740 | 2,060 | | | | 7,380 | 39,100 | 36,400 | 5,330 | 2,740 | 960 |
| 9 | 525 | 2,560 | 2,060 | | | | 7,640 | 22,700 | 29,600 | 6,340 | 2,390 | 960 |
| 10 | 525 | 2,560 | 2,060 | | 1,400 | 4,170 | 12,700 | 18,500 | 19,500 | 9,540 | 1,750 | 735 |
| 11 | 625 | 2,220 | 2,060 | | | 6,080 | 16,500 | 16,800 | 16,800 | 10,700 | 1,750 | 735 |
| 12 | 625 | 2,060 | 2,220 | | | 7,640 | 20,900 | 15,500 | 23,900 | 7,910 | 1,750 | 735 |
| 13 | 625 | 2,060 | 2,220 | 1,520 | 2,220 | 6,600 | 18,800 | 13,900 | 20,900 | 8,450 | 2,060 | 735 |
| 14 | 625 | 2,060 | 2,220 | | 3,520 | 5,830 | 16,800 | 12,700 | 16,800 | 7,380 | 1,750 | 735 |
| 15 | 625 | 2,060 | 2,390 | | 3,520 | 6,600 | 18,800 | 11,500 | 15,500 | 8,450 | 2,060 | 525 |
| 16 | 625 | 2,060 | 2,390 | | 3,730 | 30,000 | 20,600 | 10,700 | 18,100 | 7,380 | 2,060 | 525 |
| 17 | 625 | 2,390 | 3,120 | | 3,950 | 33,800 | 20,600 | 9,820 | 17,500 | 6,340 | 2,060 | 525 |
| 18 | 625 | 2,390 | 3,120 | | 3,950 | 37,400 | 18,100 | 8,990 | 16,200 | 5,330 | 1,750 | 525 |
| 19 | 625 | 2,060 | 3,320 | | 5,330 | 31,400 | 17,500 | 8,180 | 16,200 | 4,850 | 1,750 | 2,060 |
| 20 | 625 | 2,060 | 3,320 | | 6,340 | 30,900 | 17,500 | 8,180 | 18,100 | 4,390 | 1,750 | 1,750 |
| 21 | 735 | 2,060 | 3,320 | | 6,860 | 18,500 | 17,100 | 8,180 | 16,800 | 4,390 | 1,460 | 4,390 |
| 22 | 735 | 2,220 | 3,320 | | 6,080 | 15,200 | 19,200 | 8,180 | 16,800 | 4,390 | 1,460 | 6,860 |
| 23 | 735 | 2,390 | 2,930 | | 5,580 | 13,600 | 21,600 | 7,380 | 17,500 | 3,950 | 1,460 | 5,330 |
| 24 | 735 | 2,390 | 2,930 | | 5,580 | 12,700 | 25,800 | 6,860 | 18,800 | 3,520 | 1,200 | 4,390 |
| 25 | 625 | 2,390 | 2,930 | 2,390 | 5,330 | 11,500 | 27,800 | 6,340 | 17,500 | 3,520 | 1,460 | 3,120 |
| 26 | 625 | 2,560 | 3,320 | 2,560 | 5,090 | 10,700 | 31,400 | 6,080 | 16,200 | 3,120 | 1,460 | 2,060 |
| 27 | 625 | 2,390 | 3,320 | 2,560 | 3,730 | 10,100 | 27,400 | 5,580 | 15,500 | 3,120 | 1,460 | 1,750 |
| 28 | 1,900 | 3,120 | 2,060 | 2,560 | 3,120 | 9,820 | 18,100 | 5,330 | 15,500 | 2,740 | 1,200 | 2,390 |
| 29 | 1,460 | 2,060 | 1,750 | 2,560 | ..... | 9,820 | 17,100 | 5,090 | 14,900 | 2,740 | 1,200 | 2,390 |
| 30 | 1,460 | 2,060 | 1,750 | 2,560 | ..... | 9,260 | 17,100 | 4,850 | 14,500 | 2,740 | 1,200 | 3,950 |
| 31 | 2,060 | ..... | 1,750 | 2,560 | ..... | 8,990 | ..... | 4,850 | ..... | 2,740 | 1,200 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 5,830 | 2,220 | 2,220 | ..... | ..... | ..... | 12,200 | 16,000 | 7,200 | 4,240 | 4,700 | 4,940 |
| 2 | 7,120 | 1,900 | 2,220 | ..... | ..... | ..... | 13,400 | 15,600 | 9,900 | 4,470 | 4,470 | 4,470 |
| 3 | 9,540 | 1,750 | ..... | ..... | ..... | ..... | 18,800 | 14,300 | 7,720 | 5,420 | 4,240 | 4,470 |
| 4 | 7,640 | 1,750 | ..... | ..... | ..... | ..... | 17,400 | 13,100 | 7,200 | 5,920 | 4,020 | 4,700 |
| 5 | 6,340 | 1,900 | ..... | ..... | ..... | ..... | 12,200 | 12,800 | 6,420 | 7,720 | 3,800 | 5,920 |
| 6 | 5,830 | 1,900 | ..... | ..... | ..... | ..... | 10,200 | 12,200 | 6,170 | 12,200 | 3,590 | 7,990 |
| 7 | 8,720 | 1,900 | ..... | ..... | ..... | ..... | 9,620 | 11,300 | 6,170 | 11,300 | 3,390 | 7,720 |
| 8 | 6,600 | 2,740 | ..... | ..... | ..... | ..... | 9,620 | 10,500 | 6,170 | 13,400 | 3,800 | 6,420 |
| 9 | 5,090 | 2,220 | ..... | ..... | ..... | ..... | 9,620 | 9,620 | 5,920 | 13,700 | 4,940 | 6,940 |
| 10 | 4,170 | 18,500 | ..... | ..... | ..... | ..... | 8,800 | 9,070 | 7,990 | 14,700 | 5,670 | 11,600 |
| 11 | 3,520 | 18,100 | ..... | ..... | ..... | ..... | 7,990 | 8,800 | 8,530 | 17,400 | 4,940 | 13,100 |
| 12 | 3,520 | 18,500 | ..... | ..... | ..... | ..... | 7,460 | 16,300 | 7,200 | 17,700 | 4,470 | 10,500 |
| 13 | 3,120 | 15,500 | ..... | ..... | ..... | 12,500 | 7,460 | 25,100 | 5,920 | 18,400 | 4,020 | 8,530 |
| 14 | 3,120 | 11,200 | ..... | ..... | ..... | 20,600 | 7,990 | 28,700 | 5,180 | 25,500 | 3,590 | 8,260 |
| 15 | 2,740 | 8,180 | ..... | ..... | ..... | 19,800 | 7,990 | 30,400 | 4,700 | 26,600 | 3,390 | 8,260 |
| 16 | 3,120 | 6,340 | ..... | ..... | ..... | 25,900 | 7,720 | 29,100 | 4,470 | 28,700 | 3,190 | 6,420 |
| 17 | 3,120 | 5,090 | ..... | ..... | ..... | 22,400 | 7,720 | 17,400 | 4,020 | 19,100 | 3,190 | 5,420 |
| 18 | 2,390 | 4,850 | ..... | ..... | ..... | 19,500 | 7,200 | 16,300 | 3,800 | 16,000 | 3,000 | 5,180 |
| 19 | 2,220 | 4,850 | ..... | ..... | ..... | 20,200 | 7,720 | 15,300 | 3,800 | 14,000 | 2,820 | 4,700 |
| 20 | 2,060 | 4,620 | ..... | ..... | ..... | 18,000 | 26,600 | 14,300 | 3,800 | 12,200 | 2,820 | 4,240 |
| 21 | 1,900 | 4,390 | ..... | ..... | ..... | 15,000 | 33,200 | 13,100 | 4,470 | 10,700 | 2,820 | 4,020 |
| 22 | 1,600 | 4,170 | ..... | ..... | ..... | 13,400 | 23,200 | 12,200 | 4,700 | 9,900 | 2,640 | 3,590 |
| 23 | 1,900 | 3,950 | ..... | ..... | ..... | 11,900 | 23,200 | 11,300 | 4,940 | 10,200 | 3,000 | 3,390 |
| 24 | 1,900 | 3,730 | ..... | ..... | ..... | 11,000 | 20,600 | 10,700 | 4,700 | 8,800 | 3,260 | 3,190 |
| 25 | 1,900 | 3,730 | ..... | ..... | ..... | 27,000 | 20,600 | 10,200 | 4,700 | 7,990 | 9,070 | 3,190 |
| 26 | 1,900 | 3,730 | ..... | ..... | ..... | 34,700 | 15,000 | 10,200 | 4,700 | 7,460 | 8,530 | 3,000 |
| 27 | 1,900 | 3,520 | ..... | ..... | ..... | 33,700 | 18,000 | 9,900 | 4,240 | 7,200 | 7,460 | 3,000 |
| 28 | 1,750 | 3,320 | ..... | ..... | ..... | 30,400 | 19,100 | 9,070 | 4,240 | 6,680 | 6,420 | 2,820 |
| 29 | 1,600 | 3,120 | ..... | ..... | ..... | 23,600 | 17,700 | 8,530 | 4,240 | 6,170 | 5,180 | 2,820 |
| 30 | 1,460 | 2,930 | ..... | ..... | ..... | 18,400 | 15,600 | 8,260 | 4,240 | 5,420 | 5,180 | 2,820 |
| 31 | 4,170 | ..... | ..... | ..... | ..... | 14,000 | ..... | 7,720 | ..... | 5,180 | 5,180 | ..... |

NOTE.—Stage-discharge relation affected by ice, Jan. 2-24, Feb. 8-12, Mar. 2-9, 1919; observations discontinued; mean discharge ascertained by comparison with flow of this river at Keosauqua. Stage-discharge relation affected by ice Dec. 3, 1919, to Mar. 12, 1920; observations discontinued and discharge not determined. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 13,200 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 2,060 | 525 | 806 | 0.061 | 0.07 |
| November | 3,120 | 2,060 | 2,380 | .180 | .20 |
| December | 3,320 | 1,750 | 2,460 | .186 | .21 |
| January | | | 1,760 | .133 | .15 |
| February | 6,860 | | 3,430 | .260 | .27 |
| March | 37,400 | | 11,400 | .864 | 1.00 |
| April | 31,400 | 6,600 | 16,400 | 1.24 | 1.38 |
| May | 43,200 | 4,850 | 15,000 | 1.14 | 1.31 |
| June | 36,400 | 4,390 | 19,500 | 1.48 | 1.65 |
| July | 14,200 | 2,740 | 6,480 | .491 | .57 |
| August | 4,390 | 1,200 | 2,000 | .152 | .18 |
| September | 6,860 | 525 | 1,820 | .138 | .15 |
| The year | 43,200 | 525 | 6,950 | .527 | 7.14 |
| 1919–20. | | | | | |
| October | 9,540 | 1,460 | 3,800 | .288 | .33 |
| November | 18,500 | 1,750 | 5,690 | .431 | .48 |
| March 13–31 | 34,700 | 11,000 | 20,600 | 1.56 | 1.10 |
| April | 33,200 | 7,200 | 14,100 | 1.07 | 1.19 |
| May | 30,400 | 7,720 | 14,100 | 1.07 | 1.23 |
| June | 9,900 | 3,800 | 5,580 | .423 | .47 |
| July | 28,700 | 4,240 | 12,100 | .917 | 1.06 |
| August | 9,070 | 2,640 | 4,570 | .346 | .40 |
| September | 13,100 | 2,820 | 5,720 | .433 | .48 |

### DES MOINES RIVER AT KEOSAUQUA, IOWA.

LOCATION.—In sec. 36, T. 69, N., R. 10 W., at county bridge in Keosauqua, Van Buren County, a quarter of a mile above old dam site and Government locks. No important tributary enters for several miles up or down stream.

DRAINAGE AREA.—At gaging station 13,900 square miles; at mouth, 14,300 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 29, 1903, to July 21, 1906; April 5 to December 31, 1910 (United States Engineer Corps); August 3, 1911, to September 30, 1920.

GAGE.—Chain gage attached to upstream handrail of bridge; read by Frank Schreckengast.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Channel shifts considerably at flood stages. Control is a gravel bar about a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 14.35 feet at midnight March 16–17 (discharge, 45,400 second-feet); minimum stage, 0.24 foot October 14 (discharge, 474 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.1 feet at 8 a. m. March 26 (discharge, 44,100 second-feet); minimum discharge, estimated 1,000 second-feet January 28 to February 1 and March 4 (stage-discharge relation affected by ice).

1903–1906 and 1910–1920: Maximum stage recorded, 27.85 feet June 1, 1903 (discharge, 97,000 second-feet; gage height referred to datum used since 1910); minimum stage, 0.0 foot August 28 to September 6, 1911 (discharge, 160 second-feet).

Flood of June 1, 1851, reached a stage of about 24 feet (discharge, about 80,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed during ice break-up in March, 1920; slightly affected by ice in 1919, and seriously affected by ice in 1920. Two fairly well defined rating curves used, applicable, respectively, October 1, 1918, to March 14, 1920, and March 15 to September 30, 1920. Gage read to half-tenths once daily except on Sundays and during winter. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Des Moines River at Keosauqua, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 25 | H. C. Beckman | 0.40 | 667 | Jan. 23[a] | C. Herlofson | 1.82 | 1,240 |
| 1919. | | | | Aug. 10 | do | 2.47 | 5,420 |
| Sept. 13 | E. D. Burchard | .37 | 664 | | | | |
| Dec. 26[a] | C. Herlofson | 1.86 | 1,780 | | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 790 | 1,860 | 1,720 | 1,200 | 2,210 | 800 | 8,850 | 17,600 | 3,700 | 15,300 | 2,600 | 790 |
| 2 | 790 | 1,680 | 1,680 | 1,000 | 2,120 | 900 | 8,560 | 19,600 | 5,770 | 13,200 | 2,600 | 1,140 |
| 3 | 725 | 2,030 | 1,520 | 1,000 | 2,030 | 1,220 | 8,280 | 24,800 | 23,800 | 11,200 | 2,500 | 1,000 |
| 4 | 725 | 2,210 | 1,600 | 800 | 1,770 | 2,120 | 8,000 | 38,800 | 27,000 | 10,000 | 2,400 | 660 |
| 5 | 648 | 2,400 | 1,600 | 800 | 1,600 | 2,000 | 7,720 | 38,800 | 30,700 | 9,140 | 2,210 | 790 |
| 6 | 618 | 2,400 | 1,770 | 800 | 900 | 2,600 | 7,440 | 36,900 | 30,700 | 8,280 | 2,210 | 725 |
| 7 | 588 | 2,400 | 1,940 | 800 | 800 | 3,020 | 7,160 | 38,400 | 34,200 | 7,720 | 2,400 | 725 |
| 8 | 588 | 2,300 | 1,900 | 900 | 800 | 3,460 | 7,160 | 42,000 | 35,700 | 6,880 | 3,700 | 790 |
| 9 | 588 | 2,120 | 1,860 | 1,000 | 900 | 3,700 | 8,000 | 28,800 | 30,300 | 6,320 | 2,400 | 790 |
| 10 | 588 | 2,030 | 1,860 | 1,100 | 1,000 | 3,940 | 10,600 | 20,300 | 29,300 | 6,880 | 2,000 | 725 |
| 11 | 588 | 1,940 | 1,860 | 1,100 | 1,210 | 5,770 | 15,600 | 16,600 | 17,600 | 11,800 | 1,770 | 725 |
| 12 | 529 | 1,770 | 1,940 | 1,100 | 1,140 | 7,160 | 21,000 | 16,000 | 24,100 | 7,720 | 1,680 | 725 |
| 13 | 502 | 1,680 | 1,940 | 1,200 | 1,520 | 6,040 | 21,300 | 14,400 | 22,000 | 8,000 | 1,600 | 660 |
| 14 | 474 | 1,680 | 2,120 | 1,200 | 3,460 | 5,770 | 17,900 | 13,200 | 18,900 | 8,280 | 1,600 | 572 |
| 15 | 529 | 1,770 | 2,260 | 1,400 | 4,190 | 6,320 | 21,600 | 11,800 | 18,800 | 6,600 | 1,770 | 485 |
| 16 | 648 | 1,770 | 2,400 | 1,500 | 3,940 | 28,400 | 21,600 | 10,900 | 18,600 | 7,160 | 2,030 | 600 |
| 17 | 725 | 1,860 | 2,600 | 1,600 | 3,700 | 44,000 | 22,400 | 10,000 | 17,600 | 6,600 | 1,860 | 540 |
| 18 | 648 | 1,940 | 2,700 | 1,700 | 3,240 | 37,700 | 20,000 | 9,280 | 16,300 | 5,500 | 1,680 | 600 |
| 19 | 529 | 1,800 | 2,800 | 1,800 | 4,450 | 32,200 | 18,900 | 8,560 | 16,300 | 4,710 | 1,600 | 660 |
| 20 | 558 | 1,770 | 2,800 | 2,000 | 5,770 | 32,200 | 18,400 | 7,720 | 17,900 | 4,450 | 1,480 | 1,680 |
| 21 | 588 | 1,680 | 2,800 | 2,300 | 6,320 | 22,700 | 17,900 | 6,880 | 16,900 | 4,190 | 1,450 | 3,460 |
| 22 | 588 | 1,600 | 2,680 | 3,500 | 6,040 | 16,600 | 20,300 | 7,440 | 16,900 | 3,940 | 1,370 | 5,500 |
| 23 | 588 | 1,940 | 2,480 | 4,000 | 5,770 | 15,080 | 25,200 | 6,600 | 18,600 | 3,700 | 1,290 | 6,040 |
| 24 | 588 | 2,120 | 2,600 | 2,300 | 5,500 | 13,800 | 28,000 | 5,770 | 19,600 | 3,240 | 1,260 | 4,970 |
| 25 | 648 | 2,300 | 2,400 | 3,010 | 5,500 | 12,300 | 28,800 | 5,500 | 17,900 | 3,240 | 1,220 | 3,460 |
| 26 | 588 | 2,300 | 1,860 | 2,520 | 4,710 | 11,280 | 31,400 | 5,230 | 16,600 | 2,800 | 1,220 | 2,600 |
| 27 | 588 | 2,120 | 1,500 | 2,080 | 3,940 | 10,380 | 31,000 | 4,970 | 16,300 | 2,700 | 1,220 | 1,860 |
| 28 | 588 | 2,030 | 1,260 | 1,940 | 1,800 | 10,060 | 20,000 | 4,190 | 16,300 | 2,600 | 1,220 | 2,400 |
| 29 | 1,450 | 1,940 | 1,200 | 2,120 | ..... | 9,720 | 18,200 | 3,940 | 16,200 | 2,600 | 1,060 | 3,700 |
| 30 | 1,370 | 1,770 | 1,200 | 2,020 | ..... | 9,420 | 17,900 | 3,940 | 16,000 | 2,600 | 1,000 | 2,600 |
| 31 | 1,940 | ..... | 1,200 | 2,120 | ..... | 9,140 | ..... | 3,700 | ..... | 2,600 | 900 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 9,140 | 3,940 | 2,100 | 1,860 | 1,000 | 1,100 | 13,700 | 16,900 | 8,000 | 3,720 | 4,010 | 3,970 |
| 2 | 6,600 | 2,900 | 1,800 | 1,800 | 1,100 | 1,200 | 13,000 | 16,600 | 8,000 | 6,610 | 4,220 | 3,470 |
| 3 | 10,000 | 1,860 | 1,400 | 1,800 | 1,100 | 1,160 | 17,500 | 16,200 | 10,000 | 4,480 | 3,970 | 3,470 |
| 4 | 8,850 | 1,680 | 1,200 | 1,900 | 1,100 | 1,000 | 19,200 | 14,300 | 8,000 | 5,410 | 3,220 | 3,970 |
| 5 | 7,180 | 1,860 | 1,400 | 1,900 | 1,200 | 2,000 | 14,600 | 13,400 | 6,610 | 6,340 | 3,470 | 5,020 |
| 6 | 5,500 | 1,860 | 1,700 | 1,960 | 1,300 | 4,000 | 11,200 | 13,000 | 7,020 | 10,600 | 3,220 | 6,070 |
| 7 | 8,850 | 1,450 | 2,400 | 1,900 | 1,480 | 6,000 | 10,600 | 12,100 | 7,440 | 11,800 | 2,980 | 8,280 |
| 8 | 7,720 | 3,020 | 3,200 | 1,900 | 1,600 | 6,000 | 10,600 | 11,200 | 6,070 | 14,300 | 3,000 | 7,160 |
| 9 | 5,500 | 2,500 | 3,060 | 1,800 | 2,000 | 5,500 | 10,300 | 10,300 | 5,530 | 14,300 | 3,470 | 5,530 |
| 10 | 4,190 | 10,600 | 2,800 | 1,800 | 2,600 | 5,000 | 9,430 | 9,430 | 6,610 | 15,900 | 5,000 | 10,900 |
| 11 | 3,480 | 21,600 | 2,600 | 1,700 | 4,000 | 4,000 | 8,560 | 8,850 | 8,000 | 17,500 | 5,000 | 13,700 |
| 12 | 3,240 | 21,300 | 2,500 | 1,700 | 4,800 | 10,000 | 8,280 | 24,200 | 8,000 | 18,500 | 4,480 | 12,400 |
| 13 | 3,020 | 19,300 | 2,400 | 1,600 | 6,000 | 15,000 | 9,720 | 28,100 | 6,500 | 24,600 | 3,970 | 9,720 |
| 14 | 2,400 | 12,900 | 2,400 | 1,600 | 4,800 | 13,000 | 8,280 | 28,800 | 5,000 | 32,400 | 3,470 | 8,280 |
| 15 | 2,600 | 10,000 | 2,300 | 1,500 | 4,000 | 18,800 | 8,000 | 29,900 | 4,480 | 29,200 | 3,120 | 9,140 |
| 16 | 2,600 | 7,880 | 2,300 | 1,500 | 3,500 | 23,600 | 7,720 | 29,200 | 3,970 | 29,500 | 2,770 | 7,160 |
| 17 | 2,800 | 5,770 | 2,200 | 1,400 | 2,800 | 24,600 | 7,440 | 22,200 | 3,720 | 22,500 | 2,660 | 6,070 |
| 18 | 2,300 | 4,970 | 2,200 | 1,400 | 2,600 | 20,800 | 7,400 | 18,200 | 3,220 | 19,000 | 2,360 | 5,260 |
| 19 | 2,120 | 4,710 | 2,100 | 1,300 | 2,200 | 20,500 | 16,200 | 17,200 | 2,990 | 15,600 | 2,360 | 4,740 |
| 20 | 1,940 | 4,710 | 1,960 | 1,400 | 2,000 | 20,200 | 29,200 | 15,900 | 3,000 | 13,400 | 2,260 | 4,220 |
| 21 | 1,860 | 4,450 | 1,900 | 1,400 | 1,900 | 17,800 | 33,500 | 14,300 | 3,720 | 11,800 | 2,770 | 3,720 |
| 22 | 1,860 | 3,940 | 1,900 | 1,300 | 1,880 | 14,900 | 27,800 | 13,460 | 4,220 | 10,300 | 2,620 | 3,470 |
| 23 | 1,450 | 3,700 | 1,900 | 1,200 | 1,600 | 13,400 | 23,900 | 12,400 | 4,220 | 10,300 | 2,460 | 2,990 |
| 24 | 1,860 | 3,460 | 1,900 | 1,100 | 1,500 | 11,800 | 22,900 | 11,500 | 4,480 | 9,420 | 2,660 | 2,770 |
| 25 | 1,770 | 3,460 | 1,900 | 1,100 | 1,500 | 34,900 | 19,500 | 10,900 | 4,220 | 8,440 | 9,140 | 2,660 |
| 26 | 1,770 | 3,240 | 1,800 | 1,100 | 1,400 | 44,100 | 16,500 | 10,300 | 4,220 | 7,440 | 8,850 | 2,710 |
| 27 | 1,770 | 3,240 | 1,900 | 1,100 | 1,400 | 38,900 | 18,800 | 10,300 | 4,200 | 7,160 | 7,720 | 2,770 |
| 28 | 1,600 | 3,240 | 1,960 | 1,000 | 1,380 | 33,500 | 21,200 | 9,720 | 3,720 | 6,070 | 6,610 | 2,360 |
| 29 | 1,450 | 3,240 | 2,000 | 1,000 | 1,200 | 27,400 | 19,800 | 8,850 | 3,720 | 5,800 | 5,800 | 2,360 |
| 30 | 1,450 | 3,000 | 1,800 | 1,000 | ..... | 20,500 | 17,200 | 8,420 | 4,220 | 5,530 | 5,000 | 2,360 |
| 31 | 2,600 | ..... | 1,800 | 1,000 | ..... | 15,900 | ..... | 8,000 | ..... | 5,000 | 4,480 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 26, 1918, to Jan. 23, 1919, Feb. 5–10, Feb. 28 to Mar. 2, 1919, and Dec. 1, 1919, to Mar. 14, 1920; discharge ascertained by means of occasional gage readings, discharge measurements, and weather records. Gage not read on Sundays except during floods, as follows: Mar. 16 and 23, Apr. 13 and 27, May 4 and 11, 1919, June 8, 1919, Mar. 28, 1920, Apr. 4, 11, and 25, May 16, and Sept. 12, 1920. Gage not read on the following week-days: Nov. 4, 28, Dec. 18, 1918, July 4, 1919, and June 1, 1920. For days when no gage reading was obtained discharge was interpolated except for the following days, for which it was estimated: Nov. 3 and 4, 1918, June 1 and 22, July 4 and 6, Aug. 10, Sept. 7 and 28, Nov. 9 and 30, 1919, Apr. 18, June 20 and 27, July 11, and Aug. 8, 1920.

*Monthly discharge of Des Moines River at Keosauqua, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 13,900 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,940 | 474 | 707 | 0.051 | 0.06 |
| November | 2,400 | 1,600 | 1,980 | .142 | .16 |
| December | 2,800 | 1,200 | 1,990 | .143 | .16 |
| January | 4,000 | 800 | 1,670 | .120 | .14 |
| February | 6,320 | 800 | 3,080 | .222 | .23 |
| March | 44,000 | 800 | 11,900 | .856 | .99 |
| April | 31,400 | 7,160 | 17,300 | 1.24 | 1.38 |
| May | 42,000 | 3,700 | 15,600 | 1.12 | 1.29 |
| June | 35,700 | 3,700 | 20,100 | 1.45 | 1.62 |
| July | 15,300 | 2,600 | 6,450 | .464 | .53 |
| August | 3,700 | 900 | 1,780 | .128 | .15 |
| September | 6,040 | 485 | 1,730 | .124 | .14 |
| The year | 44,000 | 474 | 7,020 | .505 | 6.85 |
| 1919–20. | | | | | |
| October | 10,000 | 1,450 | 3,850 | .277 | .32 |
| November | 21,600 | 1,450 | 5,990 | .431 | .48 |
| December | 3,200 | 1,200 | 2,080 | .150 | .17 |
| January | 1,900 | 1,000 | 1,480 | .106 | .12 |
| February | 6,000 | 1,000 | 2,230 | .160 | .17 |
| March | 44,100 | 1,000 | 15,400 | 1.11 | 1.28 |
| April | 33,500 | 7,400 | 15,400 | 1.11 | 1.24 |
| May | 29,900 | 8,000 | 15,300 | 1.10 | 1.27 |
| June | 10,000 | 2,990 | 5,440 | .391 | .44 |
| July | 29,500 | 3,720 | 13,000 | .935 | 1.08 |
| August | 9,140 | 2,260 | 4,120 | .296 | .34 |
| September | 13,700 | 2,360 | 5,560 | .400 | .45 |
| The year | 44,100 | 1,000 | 7,510 | .540 | 7.36 |

### RACCOON RIVER AT VAN METER, IOWA.

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge a third of a mile from railroad station in Van Meter, Dallas County, 1 mile below mouth of South Raccoon River, and 30 miles above junction of Raccoon River with Des Moines River.

DRAINAGE AREA.—At gaging station, 3,410 square miles; at mouth, 3,590 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 25, 1915, to September 30, 1920.

GAGE.—Chain gage attached to downstream handrail of bridge about 25 feet from right abutment; read by George Cotton.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; subject to change. River divided into two channels at low and medium stages by an island, with the water surface slightly higher in the left channel than in the right at extremely low water. Right bank high and not subject to overflow; left bank subject to overflow at a stage of about 13 feet; at extremely high stage this overflow will extend for several thousand feet beyond left end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 12.42 feet at 7.30 a. m. April 24 (discharge, 12,000 second-feet); minimum stage, 1.56 feet at 7.30 a. m. October 22 (discharge, about 28 second-feet).

Maximum discharge during year ending September 30, 1920, estimated 9,000 second-feet March 13 and 14 (stage-discharge relation affected by ice jam); minimum discharge, estimated 200 second-feet January 30 and 31 (stage-discharge relation affected by ice).

1915–1920: Maximum stage recorded, 17.5 feet June 7, 1917 (discharge, 31,800 second-feet); minimum stage, 1.56 feet October 22, 1918 (discharge, about 28 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during severe winters; observations sometimes discontinued under such conditions.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 75 and 15,000 second-feet. Gage read to hundredths once daily, or thrice weekly during winter. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records excellent except for extreme low stages for which they are fair; winter records fair.

*Discharge measurements of Raccoon River at Van Meter, Iowa, during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Oct. 23 | H. C. Beckman | 2.00 | 123 | Jan. 9[a] | E. D. Burchard | 4.18 | 640 |
| 1919. | | | | Feb. 19[a] | do | 4.41 | 593 |
| Apr. 29 | E. D. Burchard | 6.55 | 3,760 | Mar. 30 | do | 5.67 | 2,690 |
| May 29 | do | 3.40 | 754 | May 14 | do | 8.30 | 5,850 |
| June 7 | do | 10.20 | 8,040 | Sept. 17 | do | 3.21 | 672 |
| Aug. 25 | do | 2.30 | 203 | | | | |
| Dec. 5[a] | do | 4.52 | 917 | | | | |

[a] Measurement made through ice.

*Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1918-19.** | | | | | | | | | | | | |
| 1 | 44 | 459 | 240 | ..... | ..... | 700 | 1,020 | 4,420 | 1,490 | 2,530 | 1,670 | 98 |
| 2 | 50 | 384 | 220 | ..... | ..... | 650 | 983 | 3,750 | 5,360 | 2,140 | 318 | 113 |
| 3 | 41 | 340 | 260 | ..... | ..... | 600 | 945 | 3,750 | 5,490 | 1,860 | 459 | 91 |
| 4 | 48 | 279 | 260 | ..... | ..... | 650 | 945 | 11,600 | 9,670 | 1,580 | 340 | 150 |
| 5 | 37 | 261 | 240 | ..... | ..... | 800 | 907 | 5,006 | 7,180 | 1,400 | 318 | 86 |
| 6 | 44 | 243 | 220 | ..... | ..... | 850 | 907 | 4,080 | 8,740 | 1,316 | 408 | 93 |
| 7 | 46 | 226 | 200 | ..... | ..... | 750 | 907 | 3,640 | 8,450 | 1,230 | 318 | 93 |
| 8 | 37 | 243 | 240 | ..... | ..... | 750 | 1,140 | 3,540 | 7,870 | 1,230 | 279 | 75 |
| 9 | 33 | 243 | 280 | ..... | ..... | 850 | 1,140 | 3,120 | 7,040 | 983 | 261 | 123 |
| 10 | 58 | 207 | 280 | ..... | ..... | 950 | 1,760 | 2,820 | 6,120 | 945 | 261 | 75 |
| 11 | 77 | 226 | 279 | ..... | ..... | 945 | 3,640 | 2,530 | 9,200 | 870 | 318 | 123 |
| 12 | 93 | 226 | 298 | ..... | ..... | 1,020 | 3,120 | 2,050 | 7,040 | 834 | 340 | 75 |
| 13 | 82 | 243 | 279 | ..... | ..... | 1,140 | 2,920 | 2,050 | 5,490 | 983 | 459 | 98 |
| 14 | 77 | 210 | 279 | ..... | ..... | 1,140 | 3,020 | 1,860 | 5,860 | 3,540 | 459 | 82 |
| 15 | 89 | 198 | 298 | ..... | ..... | 1,230 | 4,300 | 1,670 | 7,040 | 2,140 | 318 | 67 |
| 16 | 77 | 210 | 298 | ..... | ..... | 7,450 | 3,860 | 1,580 | 7,040 | 1,400 | 318 | 108 |
| 17 | 89 | 210 | 261 | ..... | ..... | 5,000 | 3,860 | 1,400 | 7,180 | 983 | 318 | 80 |
| 18 | 93 | 198 | 279 | ..... | ..... | 4,190 | 3,860 | 1,230 | 6,770 | 945 | 261 | 210 |
| 19 | 100 | 204 | 298 | ..... | 1,860 | 3,640 | 3,860 | 1,230 | 5,000 | 834 | 261 | 1,580 |
| 20 | 84 | 207 | 261 | ..... | 1,950 | 3,020 | 3,540 | 1,230 | 3,860 | 730 | 204 | 2,240 |
| 21 | 67 | 210 | 298 | ..... | 907 | 2,430 | 3,120 | 1,060 | 5,490 | 697 | 204 | 2,630 |
| 22 | 28 | 182 | 298 | ..... | 1,140 | 2,050 | 7,450 | 1,060 | 3,970 | 572 | 207 | 2,820 |
| 23 | 123 | 167 | 279 | ..... | 1,580 | 1,760 | 7,450 | 983 | 4,190 | 486 | 226 | 1,140 |
| 24 | 200 | 180 | 279 | ..... | 1,760 | 1,580 | 12,000 | 907 | 3,970 | 459 | 226 | 665 |
| 25 | 190 | 200 | 298 | ..... | 1,760 | 1,490 | 6,120 | 907 | 3,970 | 434 | 162 | 459 |
| 26 | 280 | 200 | 298 | ..... | 1,600 | 1,400 | 4,080 | 870 | 4,080 | 384 | 145 | 384 |
| 27 | 320 | 180 | 318 | ..... | 1,200 | 1,400 | 3,540 | 870 | 4,880 | 384 | 145 | 361 |
| 28 | 459 | 140 | 300 | ..... | 850 | 1,310 | 3,750 | 764 | 5,120 | 459 | 136 | 408 |
| 29 | 543 | 160 | 280 | ..... | ..... | 1,310 | 3,540 | 730 | 4,300 | 340 | 164 | 459 |
| 30 | 486 | 200 | 300 | ..... | ..... | 1,230 | 4,880 | 665 | 3,120 | 279 | 123 | 459 |
| 31 | 408 | ..... | 320 | ..... | ..... | 1,140 | ..... | 633 | ..... | 226 | 123 | ..... |
| **1919-20.** | | | | | | | | | | | | |
| 1 | 5,860 | 730 | 460 | 750 | 220 | 440 | 3,020 | 4,420 | 1,580 | 764 | 602 | 572 |
| 2 | 5,000 | 697 | 700 | 650 | 260 | 700 | 2,530 | 4,080 | 1,490 | 1,580 | 572 | 486 |
| 3 | 2,820 | 730 | 850 | 600 | 280 | 2,000 | 2,330 | 3,860 | 1,400 | 1,760 | 459 | 602 |
| 4 | 3,020 | 633 | 850 | 550 | 320 | 5,000 | 2,050 | 3,860 | 1,310 | 1,860 | 408 | 834 |
| 5 | 5,860 | 572 | 900 | 500 | 360 | 5,500 | 1,760 | 3,540 | 1,400 | 2,050 | 408 | 870 |
| 6 | 3,120 | 514 | 900 | 440 | 360 | 3,800 | 1,670 | 3,120 | 1,490 | 3,860 | 408 | 834 |
| 7 | 2,240 | 459 | 900 | 440 | 340 | 2,800 | 1,580 | 2,820 | 1,400 | 3,540 | 459 | 730 |
| 8 | 1,580 | 486 | 900 | 440 | 480 | 2,400 | 1,490 | 2,630 | 2,240 | 3,860 | 340 | 665 |
| 9 | 1,490 | 983 | 900 | 600 | 650 | 2,600 | 1,400 | 2,430 | 2,330 | 4,080 | 340 | 3,020 |
| 10 | 1,760 | 7,590 | 900 | 380 | 1,000 | 3,000 | 1,400 | 2,240 | 3,330 | 3,860 | 340 | 1,760 |
| 11 | 1,490 | 5,740 | 900 | 400 | 1,400 | 4,200 | 1,310 | 2,240 | 2,330 | 3,750 | 340 | 1,400 |
| 12 | 1,230 | 4,760 | 900 | 420 | 1,200 | 8,500 | 1,310 | 4,650 | 1,760 | 3,540 | 408 | 1,140 |
| 13 | 1,020 | 3,430 | 900 | 420 | 950 | 9,000 | 1,490 | 8,010 | 1,400 | 3,540 | 340 | 983 |
| 14 | 907 | 2,530 | 800 | 400 | 900 | 9,000 | 1,310 | 5,990 | 1,230 | 3,120 | 298 | 799 |
| 15 | 834 | 2,050 | 750 | 400 | 850 | 8,500 | 1,230 | 5,240 | 1,060 | 3,330 | 340 | 665 |
| 16 | 764 | 1,950 | 700 | 400 | 750 | 8,010 | 1,400 | 4,880 | 945 | 2,820 | 340 | 543 |
| 17 | 730 | 2,050 | 700 | 400 | 700 | 6,770 | 1,230 | 4,530 | 945 | 2,240 | 318 | 572 |
| 18 | 633 | 1,860 | 700 | 380 | 650 | 4,760 | 1,230 | 3,970 | 945 | 1,760 | 318 | 408 |
| 19 | 633 | 1,670 | 700 | 380 | 600 | 3,750 | 2,920 | 3,640 | 945 | 1,580 | 340 | 408 |
| 20 | 633 | 1,580 | 700 | 320 | 550 | 3,220 | 5,360 | 3,330 | 1,060 | 1,310 | 602 | 408 |
| 21 | 602 | 1,580 | 700 | 280 | 550 | 3,020 | 6,640 | 3,020 | 1,140 | 1,230 | 799 | 361 |
| 22 | 572 | 1,400 | 700 | 260 | 500 | 2,820 | 6,250 | 2,720 | 1,060 | 1,310 | 4,530 | 361 |
| 23 | 514 | 1,310 | 750 | 260 | 500 | 2,820 | 5,990 | 2,630 | 945 | 1,400 | 4,080 | 361 |
| 24 | 514 | 1,230 | 750 | 240 | 460 | 2,720 | 5,240 | 2,920 | 870 | 1,670 | 3,330 | 340 |
| 25 | 486 | 1,230 | 750 | 240 | 440 | 2,920 | 4,420 | 2,920 | 799 | 2,050 | 2,330 | 340 |
| 26 | 459 | 1,060 | 800 | 220 | 440 | 4,650 | 4,080 | 2,430 | 764 | 1,670 | 1,760 | 340 |
| 27 | 459 | 907 | 800 | 220 | 440 | 4,300 | 4,650 | 2,240 | 730 | 1,310 | 1,310 | 459 |
| 28 | 434 | 572 | 750 | 220 | 440 | 3,750 | 4,650 | 2,050 | 730 | 1,060 | 1,020 | 361 |
| 29 | 434 | 384 | 750 | 220 | 440 | 3,330 | 4,420 | 1,950 | 730 | 907 | 834 | 340 |
| 30 | 459 | 340 | 750 | 200 | ..... | 2,920 | 4,420 | 1,760 | 697 | 799 | 1,140 | 340 |
| 31 | 602 | ..... | 750 | 200 | ..... | 2,630 | ..... | 1,670 | ..... | 697 | 764 | ..... |

NOTE.—Stage-discharge relation affected by ice Dec. 28, 1918, to Feb. 18, 1919, and Feb. 26 to Mar. 10, 1919; observations discontinued; discharge estimated, Dec. 28–31 and Feb. 26 to Mar. 10, by comparison with flow in adjacent river basins. Stage-discharge relation affected by ice Dec. 1, 1919, to Mar. 15, 1920, discharge ascertained by means of occasional gage readings, discharge measurements, observer's notes, and weather records. Gage not read Oct. 24–27, and Nov. 24 to Dec. 10, 1918; discharge ascertained by comparison with flow in adjacent river basins.

*Monthly discharge of Raccoon River at Van Meter, Iowa, for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 3,410 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 543 | 28 | 142 | 0.042 | 0.05 |
| November | 459 | 140 | 228 | .067 | .07 |
| December | 320 | 200 | 275 | .081 | .09 |
| March | 7,450 | 600 | 1,720 | .504 | .58 |
| April | 12,000 | 907 | 3,420 | 1.00 | 1.12 |
| May | 11,600 | 633 | 2,320 | .680 | .78 |
| June | 9,670 | 1,490 | 5,830 | 1.71 | 1.91 |
| July | 3,540 | 226 | 1,070 | .314 | .36 |
| August | 1,670 | 123 | 314 | .092 | .11 |
| September | 2,820 | 67 | 515 | .151 | .17 |
| 1919–20. | | | | | |
| October | 5,860 | 434 | 1,520 | .446 | .51 |
| November | 7,590 | 340 | 1,700 | .499 | .56 |
| December | 900 | 460 | 783 | .230 | .27 |
| January | 750 | 200 | 382 | .112 | .13 |
| February | 1,400 | 220 | 587 | .172 | .19 |
| March | 9,000 | 440 | 4,190 | 1.23 | 1.42 |
| April | 6,640 | 1,230 | 2,960 | .868 | .97 |
| May | 8,010 | 1,670 | 3,410 | 1.00 | 1.15 |
| June | 3,330 | 697 | 1,300 | .381 | .43 |
| July | 4,080 | 697 | 2,200 | .645 | .74 |
| August | 4,530 | 298 | 964 | .283 | .33 |
| September | 3,020 | 340 | 710 | .208 | .23 |
| The year | 9,000 | 200 | 1,730 | .507 | 6.93 |

## ILLINOIS RIVER AT MORRIS, ILL.

LOCATION.—In sec. 9, T. 33 N., R. 7 E. third principal meridian, at highway bridge in Morris, Grundy County, 7 miles below station formerly maintained near Minooka, and 10 miles below mouth of Kankakee River.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—October 1, 1919, to September 30, 1920. January 1, 1903, to December 14, 1904, records were obtained at a station near Minooka.

GAGE.—Chain gage attached to highway bridge; installed March 1, 1916, by United States Weather Bureau; read by employee of United States Weather Bureau. A staff gage at practically the same site and datum was read once daily under the direction of United States Engineer Corps, December 10, 1899, to November 30, 1900, and April 20, 1903, to December 11, 1904.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Bed composed of sand. Dam at Marseilles, 16 miles below gage, forms control; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.8 feet April 21 (discharge, 48,000 second-feet); minimum stage, 5.2 feet August 9 (discharge, 7,600 second-feet).

A discharge of 67,800 second-feet was recorded at station near Minooka on March 26, 1904; the stage at Morris at 7 a. m. on that date was 20.45 feet.

REGULATION.—Flow at this station includes the water diverted from Lake Michigan through the Chicago Drainage canal. Operation of power plants at Lockport and Joliet causes a considerable diurnal fluctuation at low and medium stages.

ACCURACY.—Stage-discharge relation permanent during year except as affected by ice. Rating curve well defined between 10,000 and 30,000 second-feet and fairly well defined beyond these limits. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period December 10 to March 5, during which stage-discharge relation was affected by ice, for which it was ascertained by comparison with combined flow at stations on Des Plaines River at Joliet and Kankakee River at Custer Park. Records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Illinois River at Morris, Ill., during the year ending Sept. 30, 1920.*

[Made by Dean and Kane.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Mar. 30 | 13.10 | 27,200 | May 10 | 8.15 | 14,100 |
| Apr. 13 | 10.03 | 19,200 | June 9 | 6.76 | 10,900 |

*Daily discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending Sept. 30, 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9,420 | 11,000 | 11,200 | | | | 22,000 | 25,500 | 9,860 | 9,640 | 8,600 | 8,800 |
| 2 | 9,640 | 10,100 | 13,600 | | | | 20,400 | 24,900 | 11,400 | 9,200 | 8,000 | 9,000 |
| 3 | 9,200 | 9,000 | 12,900 | | | 11,000 | 18,700 | 23,300 | 11,000 | 9,000 | 9,200 | 9,000 |
| 4 | 9,000 | 10,500 | 12,400 | | | | 16,100 | 22,000 | 10,800 | 9,000 | 9,420 | 9,640 |
| 5 | 9,640 | 10,800 | 12,600 | | | | 14,100 | 20,400 | 10,800 | 9,000 | 8,800 | 8,600 |
| 6 | 10,800 | 11,900 | 11,700 | | | 15,600 | 14,400 | 18,500 | 10,800 | 9,000 | 8,400 | 8,000 |
| 7 | 9,860 | 12,200 | 11,700 | | | 13,400 | 15,100 | 17,400 | 10,300 | 9,000 | 8,000 | 8,800 |
| 8 | 9,640 | 12,200 | 10,300 | | | 11,700 | 15,600 | 16,400 | 10,100 | 9,420 | 8,600 | 9,640 |
| 9 | 9,420 | 11,200 | 9,860 | | | 13,400 | 18,000 | 14,800 | 10,300 | 9,000 | 7,600 | 9,420 |
| 10 | 9,000 | 10,300 | | | | 14,400 | 20,100 | 14,100 | 10,300 | 9,420 | 8,600 | 9,860 |
| 11 | 11,400 | 11,900 | | | | 15,400 | 18,700 | 14,100 | 9,640 | 9,200 | 8,400 | 9,640 |
| 12 | 10,100 | 11,900 | | | | 28,100 | 18,500 | 14,100 | 10,500 | 8,800 | 8,800 | 8,800 |
| 13 | 9,000 | 11,400 | | | | 44,000 | 18,500 | 17,400 | 9,860 | 9,200 | 9,420 | 8,000 |
| 14 | 9,000 | 11,400 | | | | 31,800 | 17,700 | 20,400 | 9,000 | 9,200 | 9,200 | 9,200 |
| 15 | 9,420 | 11,000 | | | 11,000 | 25,800 | 16,100 | 19,800 | 10,800 | 9,000 | 8,800 | 9,200 |
| 16 | 9,420 | 11,000 | | 10,500 | | 25,800 | 16,700 | 18,000 | 11,200 | 9,640 | 8,200 | 9,200 |
| 17 | 9,420 | 9,420 | | | | 24,400 | 23,600 | 16,900 | 9,860 | 9,860 | 9,200 | 9,200 |
| 18 | 9,420 | 11,000 | | | | 21,400 | 25,500 | 19,300 | 10,800 | 10,100 | 9,200 | 9,420 |
| 19 | 9,000 | 11,000 | | | | 21,200 | 27,200 | 20,400 | 10,800 | 9,000 | 9,420 | 9,420 |
| 20 | 8,600 | 11,000 | 10,000 | | | 20,400 | 36,500 | 20,400 | 10,500 | 9,420 | 9,000 | 8,400 |
| 21 | 9,000 | 10,800 | | | | 19,300 | 48,000 | 19,800 | 9,860 | 9,640 | 9,200 | 9,000 |
| 22 | 9,000 | 10,800 | | | | 17,200 | 44,000 | 18,500 | 10,500 | 9,640 | 8,400 | 9,000 |
| 23 | 9,000 | 10,800 | | | | 18,200 | 41,500 | 15,800 | 10,300 | 9,640 | 8,800 | 8,800 |
| 24 | 8,800 | 10,300 | | | | 20,400 | 36,500 | 15,400 | 10,100 | 9,420 | 9,200 | 8,800 |
| 25 | 9,200 | 10,300 | | | | 22,000 | 32,200 | 14,800 | 9,860 | 9,420 | 9,420 | 8,600 |
| 26 | 8,800 | 9,420 | | | | 38,500 | 27,200 | 14,100 | 9,420 | 8,600 | 9,000 | 8,400 |
| 27 | 9,200 | 10,300 | | | | 40,000 | 25,500 | 14,100 | 9,200 | 9,000 | 8,800 | 8,400 |
| 28 | 9,860 | 10,800 | | | | 33,000 | 24,100 | 13,400 | 8,800 | 9,200 | 9,000 | 9,640 |
| 29 | 9,860 | 10,500 | | | | 29,600 | 22,500 | 12,600 | 9,420 | 9,420 | 9,200 | 9,420 |
| 30 | 10,500 | 12,900 | | | ..... | 28,100 | 21,400 | 11,200 | 9,640 | 9,420 | 9,000 | 9,420 |
| 31 | 10,500 | ..... | | | ..... | 24,400 | ..... | 11,000 | ..... | 9,860 | 8,800 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending Sept. 30, 1920.*

| Month. | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| October | 11,400 | 8,600 | 9,490 |
| November | 12,900 | 9,000 | 10,900 |
| December | ..... | ..... | 10,500 |
| January | ..... | ..... | 10,500 |
| February | ..... | ..... | 11,000 |
| March | 44,000 | ..... | 21,700 |
| April | 48,000 | 14,100 | 23,900 |
| May | 25,500 | 11,000 | 17,400 |
| June | 11,400 | 8,800 | 10,200 |
| July | 10,100 | 8,600 | 9,300 |
| August | 9,420 | 7,600 | 8,830 |
| September | 9,640 | 8,000 | 9,020 |
| The year | 48,000 | 7,600 | 12,700 |

### ILLINOIS RIVER AT PEORIA, ILL.

LOCATION.—In sec. 2, T. 8, N., R. 8 E., at foot of Grant Street, Peoria, Peoria County, 3½ miles above station formerly maintained at Peoria & Pekin Union Railroad bridge and 4½ miles above mouth of Kickapoo Creek.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—March 8, 1910, to September 30, 1920; also March 10, 1903, to July 21, 1906, for station at Peoria & Pekin Union Railroad bridge.

GAGE.—Vertical staff gage attached to wooden pile; read by employee of United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from downstream side of Lower Free bridge, about 2 miles below gage.

CHANNEL AND CONTROL.—Bed of river, which forms control for medium and high stages, composed of mud; may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 23.35 feet March 23 (discharge, 54,000 second-feet); minimum stage, 9.30 feet September 18 and 19 (discharge, 9,020 second-feet).

Maximum stage recorded during year ending September 30, 1920, 23.15 feet April 25 (discharge, 53,000 second-feet); minimum stage, 9.3 feet September 9 (discharge, 9,020 second-feet).

1903–1906: Maximum discharge recorded, 57,600 second-feet March 28 and 29, 1904; minimum discharge recorded, 6,170 second-feet July 18, 19, and 20, 1906.

1910–1920: Maximum discharge recorded, 55,000 second-feet March 30 to April 2, 1913 (gage height, 22.4 feet); minimum discharge somewhat less than 7,250 second-feet during period December 11, 1916, to January 10, 1917.

The highest known flood occurred in 1844, when a stage of about 26.6 feet on the present gage was reached.

REGULATION.—Flow at this station includes water diverted from Lake Michigan through the Chicago Drainage canal. No diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 10,000 and 50,000 second-feet and fairly well defined beyond these limits. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods, January 1–31, 1919, and December 11, 1919, to March 5, 1920, during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights and comparison with flow at adjacent stations. Open-water records good; winter records poor.

COOPERATION.—Gage-height records furnished by United States Engineer Corps.

*Discharge measurements of Illinois River at Peoria, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1920. | | *Feet.* | *Sec.-ft.* |
| Mar. 29 | H. C. Beckman | 21.20 | 44,000 | Apr. 3 | H. J. Dean | 20.62 | 41,200 |
| Aug. 7 | do | 10.27 | 10,600 | | | | |

*Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1.... | 10,000 | 11,600 | 12,800 | | 18,600 | 15,900 | 39,000 | 20,700 | 21,900 | 14,800 | 10,600 | 9,440 |
| 2.... | 10,000 | 11,800 | 13,000 | | 18,400 | 16,900 | 37,400 | 20,700 | 20,700 | 14,600 | 10,300 | 9,440 |
| 3.... | 10,000 | 11,800 | 13,000 | | 17,900 | 17,200 | 35,800 | 20,700 | 20,700 | 14,200 | 10,200 | 9,440 |
| 4.... | 9,860 | 12,400 | 13,400 | | 17,900 | 17,900 | 34,600 | 21,900 | 20,400 | 13,800 | 10,000 | 9,440 |
| 5.... | 9,720 | 12,400 | 13,000 | | 17,400 | 18,900 | 33,000 | 24,400 | 20,100 | 13,800 | 10,200 | 9,300 |
| 6.... | 10,200 | 12,200 | 13,200 | | 17,200 | 18,900 | 32,200 | 27,200 | 19,500 | 14,200 | 10,200 | 9,300 |
| 7.... | 10,000 | 12,200 | 13,400 | | 16,900 | 18,900 | 30,200 | 31,400 | 19,500 | 14,000 | 10,300 | 9,160 |
| 8.... | 10,000 | 12,600 | 13,400 | | 16,400 | 18,900 | 29,400 | 35,000 | 19,500 | 13,400 | 10,400 | 9,300 |
| 9.... | 10,000 | 12,800 | 13,400 | | 15,900 | 19,200 | 28,600 | 37,400 | 18,900 | 13,200 | 10,300 | 9,440 |
| 10.... | 10,000 | 13,000 | 13,400 | | 15,600 | 18,900 | 26,200 | 38,600 | 18,400 | 13,000 | 10,200 | 9,440 |
| 11.... | 10,000 | 13,000 | 13,000 | | 15,200 | 18,900 | 25,800 | 39,000 | 17,900 | 13,000 | 10,000 | 9,300 |
| 12.... | 10,200 | 13,000 | 13,000 | | 15,200 | 18,600 | 25,800 | 39,000 | 17,900 | 12,600 | 10,000 | 9,440 |
| 13.... | 10,300 | 13,000 | 13,400 | | 15,000 | 19,500 | 25,100 | 38,600 | 17,400 | 12,400 | 9,860 | 9,300 |
| 14.... | 10,200 | 13,000 | 13,800 | | 15,200 | 20,700 | 24,400 | 37,400 | 17,200 | 12,200 | 9,720 | 9,160 |
| 15.... | 9,860 | 13,000 | 14,000 | | 15,200 | 21,600 | 23,700 | 36,600 | 16,900 | 12,200 | 9,720 | 9,160 |
| 16.... | 10,000 | 13,000 | 14,600 | 19,000 | 15,000 | 23,700 | 23,400 | 35,800 | 16,600 | 12,200 | 10,000 | 9,160 |
| 17.... | 10,000 | 13,000 | 15,200 | | 15,000 | 29,800 | 23,100 | 34,600 | 16,400 | 12,000 | 10,000 | 9,160 |
| 18.... | 10,300 | 13,200 | 14,000 | | 15,200 | 35,000 | 23,100 | 33,000 | 16,200 | 11,800 | 10,000 | 9,020 |
| 19.... | 10,200 | 13,000 | 16,400 | | 15,400 | 41,400 | 22,800 | 32,200 | 15,900 | 11,800 | 10,000 | 9,020 |
| 20.... | 10,000 | 13,000 | 17,200 | | 15,200 | 47,500 | 23,100 | 31,000 | 15,400 | 11,800 | 9,720 | 9,300 |
| 21.... | 10,200 | 13,000 | 17,600 | | 15,400 | 52,500 | 23,100 | 29,800 | 15,400 | 11,500 | 10,000 | 9,720 |
| 22.... | 10,000 | 13,200 | 18,200 | | 15,900 | 53,500 | 22,800 | 29,000 | 15,200 | 11,400 | 9,860 | 9,720 |
| 23.... | 10,000 | 13,000 | 18,900 | | 15,600 | 54,000 | 22,500 | 27,600 | 15,000 | 11,200 | 9,720 | 9,720 |
| 24.... | 10,000 | 13,000 | 21,000 | | 15,400 | 53,000 | 22,800 | 27,200 | 14,800 | 11,000 | 10,000 | 9,440 |
| 25.... | 10,300 | 13,000 | 21,000 | | 16,200 | 51,100 | 21,900 | 26,500 | 15,200 | 10,900 | 10,000 | 9,580 |
| 26.... | 10,400 | 13,000 | 21,300 | | 15,900 | 49,800 | 21,900 | 25,800 | 15,400 | 10,600 | 9,860 | 9,580 |
| 27.... | 10,300 | 12,800 | 21,900 | | 16,200 | 48,400 | 21,000 | 25,100 | 15,400 | 10,400 | 9,720 | 9,440 |
| 28.... | 10,000 | 13,000 | 22,500 | | 15,600 | 46,600 | 21,300 | 24,400 | 15,400 | 10,300 | 9,720 | 9,440 |
| 29.... | 10,800 | 13,000 | 22,800 | | ..... | 44,800 | 21,000 | 23,700 | 15,000 | 10,600 | 9,580 | 9,440 |
| 30.... | 11,200 | 13,000 | 23,400 | | ..... | 43,000 | 21,000 | 23,100 | 15,000 | 10,600 | 9,580 | 9,720 |
| 31.... | 11,500 | ..... | 23,400 | | ..... | 41,800 | ..... | 22,500 | ..... | 10,600 | 9,720 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1.... | 9,720 | 11,400 | 13,200 | | | | 43,000 | 44,800 | 21,900 | 12,200 | 10,000 | 9,440 |
| 2.... | 9,720 | 11,200 | 13,400 | | | | 41,400 | 43,900 | 21,900 | 12,200 | 9,860 | 9,440 |
| 3.... | 9,860 | 11,200 | 13,200 | | | 12,500 | 41,400 | 43,400 | 21,600 | 12,200 | 9,720 | 9,440 |
| 4.... | 10,000 | 11,200 | 13,400 | | | | 42,200 | 42,200 | 21,000 | 12,000 | 9,720 | 9,440 |
| 5.... | 10,200 | 11,500 | 13,400 | | | | 39,000 | 41,400 | 20,100 | 11,800 | 9,720 | 9,440 |
| 6.... | 10,300 | 11,500 | 13,800 | | | 15,000 | 36,600 | 39,800 | 19,500 | 11,500 | 9,720 | 9,440 |
| 7.... | 10,400 | 12,000 | 14,000 | | | 15,400 | 35,000 | 38,200 | 18,600 | 11,500 | 9,720 | 9,440 |
| 8.... | 10,600 | 12,200 | 14,200 | | | 15,600 | 33,800 | 37,000 | 18,400 | 11,400 | 9,440 | 9,300 |
| 9.... | 10,400 | 12,200 | 14,200 | | | 15,900 | 33,000 | 34,600 | 17,900 | 11,200 | 9,440 | 9,020 |
| 10.... | 10,800 | 11,200 | 14,400 | | | 15,600 | 32,600 | 33,000 | 17,400 | 11,400 | 9,440 | 9,440 |
| 11.... | 11,200 | 12,400 | | | | 17,400 | 31,800 | 31,800 | 16,900 | 11,400 | 9,440 | 9,440 |
| 12.... | 11,200 | 12,600 | | | | 19,800 | 33,000 | 31,000 | 16,600 | 11,200 | 9,440 | 9,580 |
| 13.... | 11,200 | 13,000 | | | | 23,100 | 31,800 | 31,000 | 16,200 | 11,000 | 9,440 | 9,720 |
| 14.... | 11,200 | 13,000 | | | | 27,600 | 30,200 | 30,600 | 15,600 | 11,200 | 9,580 | 9,580 |
| 15.... | 11,400 | 13,400 | | | 12,000 | 30,200 | 29,400 | 30,200 | 15,200 | 11,000 | 9,440 | 9,440 |
| 16.... | 11,600 | 13,000 | | 12,000 | | 32,600 | 31,000 | 30,200 | 14,600 | 10,900 | 9,720 | 9,440 |
| 17.... | 11,200 | 13,400 | | | | 34,200 | 30,200 | 30,200 | 15,400 | 10,900 | 9,720 | 9,720 |
| 18.... | 11,200 | 13,400 | | | | 34,200 | 31,000 | 29,400 | 15,000 | 10,900 | 9,580 | 9,440 |
| 19.... | 11,200 | 13,400 | | | | 33,400 | 32,600 | 29,400 | 14,800 | 10,900 | 9,580 | 9,720 |
| 20.... | 11,200 | 13,000 | | | | 33,400 | 37,400 | 29,000 | 14,600 | 10,800 | 9,580 | 9,720 |
| 21.... | 11,200 | 13,000 | 13,000 | | | 33,000 | 41,000 | 29,400 | 14,000 | 10,600 | 9,720 | 9,440 |
| 22.... | 11,200 | 13,000 | | | | 32,600 | 45,700 | 29,000 | 13,800 | 10,600 | 9,720 | 9,440 |
| 23.... | 10,900 | 13,000 | | | | 31,400 | 49,800 | 29,400 | 13,800 | 10,400 | 9,720 | 9,300 |
| 24.... | 11,000 | 13,000 | | | | 30,200 | 52,000 | 29,400 | 13,600 | 10,400 | 9,580 | 9,300 |
| 25.... | 10,800 | 13,000 | | | | 30,200 | 53,000 | 28,600 | 13,400 | 10,600 | 9,580 | 9,440 |
| 26.... | 11,000 | 13,600 | | | | 31,800 | 52,000 | 27,600 | 13,000 | 10,400 | 9,580 | 9,440 |
| 27.... | 11,200 | 13,000 | | | | 35,800 | 50,600 | 27,200 | 13,000 | 10,300 | 9,580 | 9,720 |
| 28.... | 10,900 | 12,800 | | | | 38,200 | 49,300 | 25,800 | 12,600 | 10,000 | 9,720 | 9,580 |
| 29.... | 10,900 | 12,600 | | | | 41,400 | 47,500 | 25,100 | 12,200 | 9,860 | 9,440 | 9,440 |
| 30.... | 10,900 | 12,400 | | | ..... | 43,000 | 46,200 | 24,000 | 12,600 | 9,860 | 9,440 | 9,720 |
| 31.... | 11,200 | ..... | | | ..... | 43,000 | ..... | 23,100 | ..... | 9,720 | 9,580 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Month. | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| 1918-19. | | | |
| October | 11,500 | 9,720 | 10,200 |
| November | 13,200 | 11,600 | 12,800 |
| December | 23,400 | 12,800 | 16,400 |
| January | | | 19,000 |
| February | 18,600 | 15,000 | 16,100 |
| March | 54,000 | 15,900 | 32,200 |
| April | 39,000 | 21,000 | 26,200 |
| May | 39,000 | 20,700 | 29,700 |
| June | 21,900 | 14,800 | 17,300 |
| July | 14,800 | 10,300 | 12,300 |
| August | 10,600 | 8,580 | 9,980 |
| September | 9,720 | 9,020 | 9,380 |
| The year | 54,000 | 9,020 | 17,600 |
| 1919-20. | | | |
| October | 11,600 | 9,720 | 10,800 |
| November | 13,600 | 11,200 | 12,500 |
| December | | | 13,200 |
| January | | | 12,000 |
| February | | | 12,000 |
| March | 43,000 | | 26,300 |
| April | 53,000 | 29,400 | 39,400 |
| May | 44,800 | 23,100 | 32,200 |
| June | 21,900 | 12,200 | 16,200 |
| July | 12,200 | 9,720 | 11,000 |
| August | 10,000 | 9,440 | 9,610 |
| September | 9,720 | 9,020 | 9,480 |
| The year | 53,000 | 9,020 | 17,100 |

### KANKAKEE RIVER AT MOMENCE, ILL.

LOCATION.—In sec. 24, T. 31 N., R. 13 E., at highway bridge in Momence, Kankakee County, half a mile below Chicago & Eastern Illinois Railroad bridge and 1½ miles above Tower Creek.

DRAINAGE AREA.—2,340 square miles.

RECORDS AVAILABLE.—February 24, 1905, to July 20, 1906; December 3, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge over left channel; read by Henry Hanson.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; may shift. River at gage divided into two channels by an island. Aquatic plants sometimes grow in bed of river during summer.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year ending September 30, 1919, 4.65 feet at 8 a. m. March 20 (discharge, 7,200 second-feet); minimum stage, 1.37 feet September 1, 16, and 17 (discharge, 306 second-feet).

Maximum open-water stage recorded during year ending September 30, 1920, 4.2 feet April 22 (discharge, 5,940 second-feet); minimum stage, 1.42 feet August 28 (discharge, 350 second-feet).

1905–6 and 1915–1920: Maximum stage recorded, 7.75 feet January 4, 1919 (discharge not determined because of backwater from ice); maximum open-water stage, 6.4 feet January 22, 1916 (discharge, estimated from extension of rating curve, 12,600 second-feet); minimum stage, 1.37 feet September 1, 16, and 17, 1919 (discharge, 306 second-feet).

ACCURACY.—Stage-discharge relation changed following the high water of April and May, 1920; slightly affected by ice during 1919; seriously affected by ice during 1920. Two rating curves used, both fairly well defined below 2,500 second-feet and poorly defined above that point; applicable respectively, October 1, 1918, to May 31, 1920, and June 1 to September 30, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods January 1–20, 1919, and December 10, 1919, to March 11, 1920, during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, observer's notes, and weather records. Indirect method for shifting control used June 1–30, 1920. Open-water records fair except for high stages for which they are subject to error; winter records poor.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Kankakee River at Momence, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Dec. 2 | 2.05 | 1,060 | July 5 | 1.74 | 719 | Sept. 4 | 1.48 | 402 |
| June 4 | 2.39 | 1,590 | 29 | 1.44 | 380 | | | |

*Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 540 | 1,060 | 1,060 | | 1,680 | 2,700 | 4,100 | 2,480 | 1,960 | 820 | 540 | 306 |
| 2 | 510 | 1,000 | 1,060 | | 1,590 | 2,590 | 3,830 | 2,700 | 1,860 | 760 | 519 | 435 |
| 3 | 510 | 1,000 | 1,060 | | 1,590 | 2,700 | 3,570 | 2,820 | 1,770 | 760 | 498 | 435 |
| 4 | 530 | 940 | 1,200 | | 1,500 | 2,590 | 3,570 | 3,330 | 1,680 | 738 | 488 | 435 |
| 5 | 530 | 940 | 1,200 | | 1,420 | 2,590 | 3,310 | 4,930 | 1,500 | 705 | 466 | 405 |
| | | | | 3,300 | | | | | | | | |
| 6 | 530 | 880 | 1,060 | | 1,420 | 2,370 | 3,310 | 4,930 | 1,420 | 705 | 508 | 365 |
| 7 | 519 | 880 | 1,060 | | 1,420 | 2,370 | 2,940 | 4,930 | 1,310 | 650 | 498 | 365 |
| 8 | 519 | 940 | 1,130 | | 1,420 | 2,370 | 2,700 | 4,930 | 1,270 | 650 | 488 | 355 |
| 9 | 519 | 1,060 | 1,200 | | 1,420 | 2,370 | 2,590 | 4,930 | 1,270 | 628 | 466 | 335 |
| 10 | 551 | 1,060 | 1,200 | | 1,500 | 2,260 | 2,700 | 4,930 | 1,200 | 595 | 456 | 335 |
| 11 | 562 | 1,060 | 1,200 | | 1,500 | 2,370 | 2,370 | 4,650 | 1,130 | 540 | 435 | 355 |
| 12 | 562 | 1,060 | 1,270 | | 1,590 | 2,700 | 2,260 | 4,650 | 1,130 | 510 | 435 | 316 |
| 13 | 562 | 1,060 | 1,420 | | 1,500 | 2,940 | 2,160 | 4,650 | 1,060 | 505 | 435 | 305 |
| 14 | 573 | 1,060 | 2,160 | | 1,680 | 3,310 | 2,160 | 4,650 | 1,200 | 595 | 435 | 316 |
| 15 | 573 | 1,060 | 2,370 | | 1,590 | 3,830 | 2,260 | 4,650 | 1,130 | 595 | 385 | 316 |
| | | | | 2,550 | | | | | | | | |
| 16 | 573 | 1,060 | 2,590 | | 1,590 | 5,480 | 2,260 | 4,650 | 1,130 | 562 | 435 | 306 |
| 17 | 562 | 1,060 | 2,700 | | 1,590 | 5,940 | 2,260 | 4,650 | 1,130 | 595 | 456 | 306 |
| 18 | 562 | 1,060 | 2,700 | | 1,590 | 7,060 | 2,260 | 4,370 | 1,060 | 628 | 435 | 316 |
| 19 | 562 | 1,060 | 2,700 | | 1,590 | 7,060 | 2,260 | 4,370 | 1,000 | 650 | 435 | 355 |
| 20 | 562 | 1,060 | 2,820 | | 1,590 | 7,060 | 2,160 | 4,100 | 1,130 | 595 | 415 | 335 |
| 21 | 562 | 1,060 | 3,310 | 2,060 | 1,590 | 7,060 | 2,160 | 3,830 | 1,130 | 584 | 435 | 385 |
| 22 | 562 | 1,060 | 3,830 | 2,060 | 1,590 | 6,500 | 2,160 | 3,570 | 1,200 | 510 | 385 | 435 |
| 23 | 562 | 1,060 | 3,830 | 2,060 | 1,590 | 6,220 | 2,260 | 3,310 | 1,130 | 510 | 385 | 415 |
| 24 | 573 | 1,060 | 4,370 | 1,960 | 1,590 | 5,940 | 2,480 | 3,060 | 1,130 | 530 | 375 | 405 |
| 25 | 705 | 1,060 | 4,370 | 1,960 | 1,680 | 5,480 | 2,370 | 2,940 | 1,060 | 488 | 385 | 435 |
| 26 | 1,270 | 1,060 | 4,370 | 1,960 | 2,160 | 5,210 | 2,370 | 2,700 | 1,000 | 456 | 375 | 415 |
| 27 | 1,270 | 1,060 | 4,370 | 1,960 | 2,160 | 4,930 | 2,260 | 2,590 | 1,000 | 488 | 335 | 405 |
| 28 | 1,200 | 1,060 | 4,100 | 1,960 | 2,370 | 4,930 | 2,370 | 2,370 | 940 | 435 | 335 | 385 |
| 29 | 1,200 | 1,060 | 4,370 | 1,960 | ..... | 4,930 | 2,370 | 2,260 | 880 | 385 | 335 | 365 |
| 30 | 1,130 | 1,060 | 4,100 | 1,960 | ..... | 4,650 | 2,370 | 2,160 | 880 | 488 | 355 | 395 |
| 31 | 1,060 | ..... | 3,830 | 1,860 | ..... | 4,370 | ..... | 2,060 | ..... | 385 | 335 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 508 | 628 | 1,270 | | | | 3,060 | 5,940 | 1,770 | 745 | 514 | 410 |
| 2 | 530 | 650 | 1,270 | | | | 3,060 | 5,760 | 1,680 | 800 | 504 | 402 |
| 3 | 584 | 705 | 1,310 | | | 2,150 | 2,590 | 5,760 | 1,590 | 855 | 495 | 388 |
| 4 | 628 | 683 | 1,420 | | | | 2,590 | 5,480 | 1,500 | 800 | 495 | 372 |
| 5 | 628 | 694 | 1,680 | | | | 2,370 | 4,930 | 1,420 | 745 | 486 | 395 |
| | | | | | 1,500 | | | | | | | |
| 6 | 617 | 705 | 1,500 | | | | 2,370 | 4,930 | 1,340 | 745 | 495 | 444 |
| 7 | 595 | 705 | 1,420 | | | | 2,370 | 4,370 | 1,270 | 745 | 504 | 436 |
| 8 | 562 | 683 | 1,420 | | | 2,400 | 2,480 | 4,370 | 1,270 | 745 | 495 | 461 |
| 9 | 510 | 650 | 1,500 | | | | 2,820 | 4,100 | 1,200 | 745 | 495 | 495 |
| 10 | 540 | 683 | | | | | 2,940 | 3,830 | 1,200 | 745 | 495 | 486 |
| 11 | 540 | 705 | | | | | 2,940 | 3,570 | 1,130 | 745 | 486 | 478 |
| 12 | 540 | 672 | 1,600 | | | 5,480 | 2,820 | 3,310 | 1,060 | 745 | 470 | 461 |
| 13 | 530 | 672 | | | 2,150 | 4,930 | 2,820 | 3,830 | 1,000 | 690 | 478 | 444 |
| 14 | 540 | 650 | | | | 5,210 | 2,590 | 3,830 | 1,000 | 745 | 452 | 436 |
| 15 | 519 | 650 | | | | 5,210 | 2,590 | 3,310 | 1,060 | 855 | 444 | 410 |
| | | | | 1,150 | | | | | | | | |
| 16 | 519 | 650 | | | | 5,210 | 2,700 | 3,060 | 1,060 | 910 | 436 | 452 |
| 17 | 508 | 650 | | | | 4,100 | 3,830 | 3,060 | 1,200 | 910 | 427 | 410 |
| 18 | 498 | 639 | | | | 3,830 | 3,830 | 3,830 | 1,310 | 970 | 427 | 413 |
| 19 | 488 | 617 | | | | 3,830 | 4,650 | 3,830 | 1,200 | 910 | 410 | 410 |
| 20 | 488 | 650 | | | | 3,830 | 5,760 | 3,830 | 1,270 | 855 | 410 | 410 |
| 21 | 477 | 639 | | | | 3,830 | 5,760 | 3,310 | 1,200 | 800 | 418 | 395 |
| 22 | 488 | 628 | | | | 3,570 | 5,940 | 3,060 | 1,130 | 745 | 410 | 395 |
| 23 | 477 | 617 | | | 1,650 | 3,310 | 5,480 | 2,940 | 1,060 | 690 | 402 | 388 |
| 24 | 488 | 628 | 1,350 | | | 3,310 | 5,480 | 2,700 | 1,060 | 640 | 395 | 388 |
| 25 | 466 | 672 | | | | 3,310 | 5,480 | 2,590 | 1,000 | 590 | 372 | 380 |
| 26 | 488 | 661 | | | | 4,370 | 4,930 | 2,370 | 940 | 590 | 372 | 372 |
| 27 | 488 | 650 | | | | 4,100 | 4,930 | 2,370 | 880 | 552 | 365 | 410 |
| 28 | 519 | 650 | | | | 4,100 | 4,930 | 2,260 | 820 | 542 | 350 | 410 |
| 29 | 530 | 760 | | | | 4,100 | 4,930 | 2,060 | 760 | 524 | 380 | 402 |
| 30 | 573 | 1,500 | | | ..... | 3,830 | 4,930 | 1,960 | 760 | 524 | 395 | 410 |
| 31 | 595 | ..... | | | ..... | 3,310 | ..... | 1,860 | ..... | 524 | 410 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kankakee River at Momence, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,340 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,270 | 519 | 680 | 0.291 | 0.34 |
| November | 1,060 | 880 | 1,030 | .440 | .49 |
| December | 4,370 | 1,060 | 2,520 | 1.08 | 1.24 |
| January | | 1,860 | 2,590 | 1.11 | 1.28 |
| February | 2,370 | 1,720 | 1,630 | .697 | .73 |
| March | 7,060 | 2,260 | 4,260 | 1.83 | 2.11 |
| April | 4,100 | 2,160 | 2,610 | 1.12 | 1.25 |
| May | 4,930 | 2,060 | 3,800 | 1.62 | 1.87 |
| June | 1,960 | 880 | 1,220 | .521 | .58 |
| July | 820 | 385 | 588 | .251 | .29 |
| August | 540 | 335 | 428 | .183 | .21 |
| September | 435 | 306 | 369 | .158 | .18 |
| The year | 7,060 | 306 | 1,820 | .778 | 10.57 |
| 1919–20. | | | | | |
| October | 628 | 466 | 532 | .227 | .26 |
| November | 1,500 | 617 | 692 | .296 | .33 |
| December | | | 1,420 | .607 | .70 |
| January | | | 1,150 | .491 | .57 |
| February | | | 1,680 | .718 | .77 |
| March | 5,480 | | 3,490 | 1.49 | 1.72 |
| April | 5,910 | 2,370 | 3,800 | 1.62 | 1.81 |
| May | 5,910 | 1,860 | 3,630 | 1.55 | 1.79 |
| June | 1,770 | 760 | 1,170 | .500 | .56 |
| July | 970 | 521 | 733 | .313 | .36 |
| August | 514 | 350 | 442 | .189 | .22 |
| September | 495 | 372 | 419 | .179 | .20 |
| The year | 5,940 | 350 | 1,600 | .684 | 9.29 |

## KANKAKEE RIVER AT CUSTER PARK, ILL.

LOCATION.—In sec. 19, T. 32 N., R. 10 E., at Wabash Railroad bridge in Custer Park, Will County, half a mile above Horse Creek and 15 miles below dam and power plant at Kankakee.

DRAINAGE AREA.—4,870 square miles.

RECORDS AVAILABLE.—November 6, 1914, to September 30, 1920.

GAGE.—Chain gage, attached to bridge; read by J. H. Swords.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of solid rock strewn with boulders and gravel. Right half of channel deep with fissures in bed; left half shallow; may shift slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 12.75 feet at 8 a. m. March 18 (discharge, 21,800 second-feet); minimum stage, 4.80 feet September 2, 8, and 11 (discharge, 350 second-feet).

Maximum stage recorded during year ending September 30, 1920, 13.45 feet April 20 (discharge, 24,300 second-feet); minimum stage, 4.74 feet September 29 (discharge, 344 second-feet).

1914–1920: Maximum stage recorded, 14.0 feet February 14, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.45 feet April 20, 1920 (discharge, 24,300 second-feet); minimum stage, 4.09 feet November 15, 1914 (discharge not determined); minimum mean daily discharge, 250 second-feet November 15 and 18, 1914.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plant at Kankakee causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation changed slightly after flood of March, 1919; seriously affected by ice. Two rating curves used, both fairly well defined above 3,500 second-feet and poorly defined below that point, applicable, respectively, October 1, 1918, to May 25, 1919, and May 26, 1919, to September 30, 1920. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair for high stages, and poor for low and medium stages; winter records poor.

No discharge measurements were made at this station during the year ending September 30, 1920.

*Discharge measurements of Kankakee River at Custer Park, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Oct. 2..... | 5.19 | 634 | June 23..... | 6.73 | 3,050 | Aug. 1..... | 5.07 | 415 |

*Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 634 | 3,270 | 2,150 | 7,880 | 3,070 | 6,170 | 6,440 | 3,680 | 3,010 | 1,640 | 580 | 460 |
| 2 | 680 | 2,880 | 2,230 | 7,580 | 2,880 | 6,170 | 5,900 | 4,630 | 2,800 | 1,480 | 670 | 350 |
| 3 | 634 | 2,410 | 2,150 | | 2,690 | 5,640 | 5,640 | 5,640 | 2,610 | 1,410 | 670 | 500 |
| 4 | 546 | 2,150 | 2,150 | | 2,690 | 5,640 | 5,130 | 8,480 | 2,240 | 1,270 | 720 | 500 |
| 5 | 527 | 1,900 | 1,980 | | | 5,380 | 5,130 | 12,300 | 2,240 | 1,270 | 720 | 460 |
| 6 | 536 | 1,660 | 1,900 | 5,190 | | 4,880 | 4,630 | 13,600 | 2,060 | 1,000 | 670 | 500 |
| 7 | 565 | 1,510 | 1,820 | | | 4,630 | 4,390 | 13,600 | 1,980 | 1,130 | 670 | 500 |
| 8 | 600 | 1,660 | 1,740 | | | 4,630 | 4,150 | 12,600 | 1,890 | 1,000 | 620 | 385 |
| 9 | 546 | 1,820 | 1,660 | | 2,260 | 4,390 | 3,680 | 12,300 | 1,720 | 1,000 | 620 | 460 |
| 10 | 489 | 1,980 | 1,820 | | | 4,150 | 3,680 | 11,600 | 1,980 | 1,000 | 620 | 420 |
| 11 | 527 | 2,150 | 2,600 | | | 4,630 | 3,470 | 10,700 | 2,060 | 880 | 620 | 350 |
| 12 | 565 | 2,410 | 4,390 | | | 5,640 | 3,270 | 9,720 | 1,720 | 880 | 670 | 420 |
| 13 | 565 | 2,320 | 5,640 | | 2,060 | 7,000 | 3,270 | 8,790 | 1,560 | 880 | 540 | 420 |
| 14 | 462 | 2,150 | 7,290 | | 2,320 | 7,880 | 3,270 | 7,880 | 1,560 | 880 | 580 | 406 |
| 15 | 622 | 2,060 | 9,100 | 3,850 | 2,880 | 10,400 | 3,470 | 7,290 | 1,890 | 940 | 620 | 406 |
| 16 | 438 | 1,980 | 10,000 | | 3,270 | 18,100 | 3,680 | 7,000 | 1,800 | 770 | 580 | 420 |
| 17 | 622 | 1,820 | 10,400 | | 3,680 | 20,600 | 4,150 | 6,720 | 1,800 | 820 | 580 | 420 |
| 18 | 527 | 1,820 | 9,720 | 3,470 | 3,680 | 21,600 | 4,150 | 6,170 | 1,720 | 820 | 580 | 460 |
| 19 | 489 | 1,900 | 8,480 | 3,070 | 3,470 | 20,600 | 3,910 | 5,900 | 1,800 | 940 | 580 | 420 |
| 20 | 576 | 1,980 | 7,880 | 3,070 | 3,270 | 19,800 | 3,910 | 5,640 | 2,060 | 770 | 580 | 460 |
| 21 | 498 | 1,980 | 8,790 | 3,070 | 3,070 | 18,400 | 3,680 | 5,130 | 2,060 | 770 | 580 | 540 |
| 22 | 546 | 1,980 | 11,300 | 3,070 | 2,880 | 16,700 | 3,470 | 5,130 | 3,010 | 770 | 580 | 500 |
| 23 | 565 | 1,980 | 12,300 | 3,070 | 2,880 | 16,000 | 3,470 | 4,880 | 3,220 | 770 | 540 | 500 |
| 24 | 810 | 1,980 | 13,300 | 3,270 | 3,270 | 12,600 | 3,470 | 5,130 | 3,010 | 770 | 580 | 500 |
| 25 | 1,000 | 1,900 | 13,600 | 3,270 | 4,150 | 11,000 | 3,470 | 4,880 | 2,800 | 820 | 580 | 500 |
| 26 | 1,360 | 1,820 | 13,300 | 3,680 | 5,380 | 10,000 | 3,270 | 4,630 | 2,800 | 670 | 540 | 484 |
| 27 | 1,440 | 2,880 | 12,600 | 3,680 | 5,640 | 9,100 | 3,270 | 4,380 | 3,010 | 670 | 540 | 500 |
| 28 | 2,410 | 1,820 | 12,000 | 3,680 | 5,640 | 8,480 | 3,270 | 3,670 | 2,800 | 720 | 540 | 500 |
| 29 | 3,070 | 1,980 | 10,000 | 3,470 | ..... | 7,880 | 3,270 | 3,440 | 2,240 | 670 | 500 | 500 |
| 30 | 3,680 | 1,980 | 8,790 | 3,470 | ..... | 7,290 | 3,270 | 3,010 | 1,890 | 620 | 484 | 580 |
| 31 | 3,910 | ..... | 8,180 | 3,270 | ..... | 7,000 | ..... | 3,220 | ..... | 670 | 500 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 670 | 670 | | | | | 6,170 | 12,000 | 2,420 | 1,060 | 620 | 580 |
| 2 | 670 | 620 | | | | 1,400 | 5,260 | 11,000 | 2,240 | 1,000 | 670 | 580 |
| 3 | 620 | 880 | | | | | 4,380 | 10,000 | 2,240 | 1,270 | 670 | 580 |
| 4 | 620 | 910 | | | 1,600 | 2,610 | 3,910 | 9,410 | 2,150 | 940 | 670 | 580 |
| 5 | 720 | 940 | | | | 7,880 | 3,440 | 7,880 | 2,060 | 1,060 | 620 | 540 |
| 6 | 720 | 880 | | | | 5,130 | 3,220 | 7,290 | 1,980 | 1,060 | 720 | 540 |
| 7 | 670 | 940 | | | | 4,880 | 3,440 | 6,440 | 1,800 | 1,060 | 720 | 580 |
| 8 | 720 | 880 | 2,500 | | | 4,630 | 4,140 | 5,900 | 1,720 | 1,060 | 670 | 580 |
| 9 | 620 | 880 | | | | 4,140 | 5,900 | 5,380 | 1,640 | 1,060 | 720 | 820 |
| 10 | 620 | 940 | | | | 5,130 | 4,380 | 4,880 | 1,480 | 1,000 | 720 | 820 |
| 11 | 620 | 820 | | | 3,200 | 5,380 | 7,000 | 4,630 | 1,410 | 940 | 770 | 770 |
| 12 | 620 | 1,000 | | | | 22,300 | 7,000 | 4,630 | 1,410 | 940 | 670 | 540 |
| 13 | 620 | 880 | | | | 16,000 | 5,900 | 6,720 | 1,270 | 1,130 | 670 | 580 |
| 14 | 620 | 720 | | | | 14,000 | 5,130 | 7,880 | 1,340 | 1,000 | 670 | 770 |
| 15 | 580 | 820 | | | | 13,000 | 4,630 | 8,480 | 1,560 | 1,200 | 620 | 500 |
| 16 | 620 | 720 | | 1,400 | | 12,300 | 4,630 | 7,580 | 1,640 | 1,200 | 670 | 580 |
| 17 | 620 | 770 | | | | 10,000 | 9,720 | 7,000 | 1,720 | 1,270 | 620 | 540 |
| 18 | 620 | 820 | | | | 8,790 | 11,300 | 8,180 | 1,800 | 1,410 | 620 | 540 |
| 19 | 600 | 720 | | | | 7,880 | 17,700 | 9,100 | 1,800 | 1,340 | 620 | 500 |
| 20 | 580 | 720 | | | | 7,290 | 24,100 | 9,720 | 1,720 | 1,270 | 620 | 500 |
| 21 | 500 | 670 | | | | 7,000 | 23,400 | 8,790 | 1,560 | 1,200 | 620 | 500 |
| 22 | 500 | 880 | | | | 6,720 | 23,800 | 7,580 | 1,560 | 1,060 | 540 | 492 |
| 23 | 500 | 720 | | | 1,750 | 6,170 | 22,700 | 6,720 | 1,480 | 1,060 | 580 | 428 |
| 24 | 500 | 670 | 1,850 | | | 5,900 | 19,800 | 5,640 | 1,410 | 940 | 580 | 428 |
| 25 | 500 | 770 | | | | 5,900 | 16,400 | 4,880 | 1,410 | 820 | 620 | 476 |
| 26 | 500 | 770 | | | | 9,720 | 14,300 | 4,140 | 1,340 | 940 | 540 | 492 |
| 27 | 540 | 720 | | | | 9,720 | 12,300 | 3,900 | 1,340 | 940 | 540 | 720 |
| 28 | 580 | 720 | | | | 10,000 | 10,700 | 3,440 | 1,340 | 820 | 580 | 580 |
| 29 | 620 | 880 | | | | 10,700 | 10,000 | 3,220 | 1,000 | 620 | 540 | 344 |
| 30 | 670 | 2,150 | | | ..... | 8,790 | 10,700 | 3,010 | 1,130 | 720 | 580 | 540 |
| 31 | 670 | ..... | | | ..... | 7,580 | ..... | 2,610 | ..... | 820 | 580 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 3–17, Feb. 5–12, 1919, and Dec. 1, 1919, to Mar. 3, 1920; mean discharge ascertained by means of gage heights, observer's notes, and weather records. Owing to lack of gage readings discharge interpolated Oct. 19, and Nov. 4, 1919, Mar. 7, Apr. 2, 4, and 19, 1920. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kankakee River at Custer Park, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 4,870 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 3,910 | 438 | 982 | 0.202 | 0.23 |
| November | 3,270 | 1,510 | 2,070 | .425 | .47 |
| December | 13,600 | 1,660 | 7,070 | 1.45 | 1.67 |
| January | 7,880 | 3,070 | 4,210 | .864 | 1.00 |
| February | 5,640 | 2,060 | 3,110 | .639 | .67 |
| March | 21,600 | 4,150 | 10,100 | 2.07 | 2.39 |
| April | 6,440 | 3,270 | 3,970 | .815 | .91 |
| May | 13,600 | 3,010 | 7,150 | 1.47 | 1.70 |
| June | 3,220 | 1,560 | 2,240 | .460 | .51 |
| July | 1,640 | 620 | 926 | .190 | .22 |
| August | 720 | 484 | 595 | .122 | .14 |
| September | 580 | 350 | 461 | .095 | .11 |
| The year | 21,600 | 350 | 3,590 | .737 | 10.02 |
| 1919–20. | | | | | |
| October | 720 | 500 | 607 | .125 | .14 |
| November | 2,150 | 620 | 849 | .174 | .19 |
| December | ..... | ..... | 2,160 | .444 | .51 |
| January | ..... | ..... | 1,400 | .287 | .33 |
| February | ..... | ..... | 2,170 | .446 | .48 |
| March | 22,300 | ..... | 7,860 | 1.61 | 1.86 |
| April | 24,100 | 3,220 | 10,200 | 2.09 | 2.33 |
| May | 12,000 | 2,610 | 6,710 | 1.38 | 1.59 |
| June | 2,420 | 1,000 | 1,630 | .335 | .37 |
| July | 1,410 | 620 | 1,040 | .214 | .25 |
| August | 770 | 540 | 634 | .130 | .15 |
| September | 820 | 344 | 567 | .116 | .13 |
| The year | 24,100 | 344 | 2,990 | .614 | 8.33 |

### DES PLAINES RIVER AT LEMONT, ILL.

LOCATION.—In sec. 20, T. 37 N., R. 11 E., at concrete highway bridge on Stephens Street, a quarter of a mile north of main section of Lemont, Cook County, and 8 miles above junction of Des Plaines River and Chicago Drainage canal.

DRAINAGE AREA.—705 square miles.

RECORDS AVAILABLE.—November 4, 1914, to September 30, 1920.

GAGE.—Staff gage attached to bridge; read by William Weck, jr.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading below dam.

CHANNEL AND CONTROL.—A concrete dam, forming a new control and changing former stage-discharge relation, was built across channel about 500 feet below gage August 20, 1916; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 6.5 feet at 8.30 a. m. March 18 (discharge, 5,520 second-feet); minimum discharge, no flow, September 7, 8, 14–21, and 24–27 (caused by regulation).

Maximum stage recorded during year ending September 30, 1920, 6.1 feet at 8.30 a. m. March 27 (discharge, 4,330 second-feet); minimum stage, 2.40 feet August 26 and September 12 and 13 (discharge, 0.5 second-foot).

1915–1920: Maximum stage recorded, 6.6 feet February 16, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 6.5 feet March 18, 1919 (discharge, 5,520 second-feet); minimum discharge, no flow, September 7, 8, 14–21, and 24–27, 1919 (caused by regulation).

DIVERSIONS.—During high water part of flow of river spills over into Chicago Drainage canal at Willow Springs, 7 miles above station. The Chicago Sanitary District has obtained records of this overflow during the years 1915 to 1919, as shown in the following table:

*Overflow from Des Plaines River into Chicago Drainage canal at Willow Springs, Ill.*

| Date. | Overflow. | Date. | Overflow. | Date. | Overflow. |
|---|---|---|---|---|---|
| 1915. | *Sec.-ft.* | 1916. | *Sec.-ft.* | 1918. | *Sec.-ft.* |
| May 31 | 220 | June 12 | 830 | Mar. 6 | 210 |
| June 1 | 320 | 13 | 410 | 7 | 50 |
| 2 | 1,190 | 14 | 120 | 14 | 30 |
| 3 | 320 | | | 15 | 280 |
| | | 1918. | | 16 | 200 |
| 1916. | | Feb. 14 | 200 | 17 | 80 |
| Jan. 21 | 150 | 15 | 1,480 | | |
| 22 | 2,800 | 16 | 2,500 | 1919. | |
| 23 | 3,600 | 17 | 1,650 | Mar. 14 | 200 |
| 24 | 1,470 | 18 | 580 | 15 | 130 |
| 25 | 580 | 19 | 500 | 16 | 1,330 |
| 26 | 350 | 20 | 500 | 17 | 3,850 |
| 27 | 200 | 21 | 500 | 18 | 4,900 |
| 28 | 120 | 22 | 500 | 19 | 3,850 |
| 29 | 80 | 23 | 270 | 20 | 2,600 |
| Mar. 27 | 50 | 24 | 30 | 21 | 1,250 |
| 28 | 1,620 | 25 | 80 | 22 | 330 |
| 29 | 1,860 | 26 | 200 | 23 | 50 |
| 30 | 1,860 | 27 | 310 | May 4 | 1,200 |
| 31 | 1,000 | 28 | 280 | 5 | 3,450 |
| Apr. 1 | 520 | Mar. 1 | 290 | 6 | 3,260 |
| 2 | 310 | 2 | 280 | 7 | 1,720 |
| 3 | 100 | 3 | 200 | 8 | 780 |
| June 9 | 500 | 4 | 210 | 9 | 310 |
| 10 | 1,710 | 5 | 200 | 10 | 30 |
| 11 | 1,370 | | | | |

NOTE.—No overflow during 1917. No record of overflow was obtained during 1920, although overflow probably occurred on about 15 days during March.

ACCURACY.—Stage-discharge relation permanent except as affected by ice during 1920. Rating curve well defined below 5,500 second-feet; extended above that point. Gage read to half-tenths or hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for days when gage was not read for which it was interpolated, and except for period December 5, 1919, to March 3, 1920, during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by means of gage heights, observer's notes, and weather records. Open-water records good except those for very low stages which are fair; winter records fair.

Published results for discharge in second-feet per square mile and run-off in inches for months in which high stages occurred during the period of 1915 to 1918 are incorrect, owing to fact that overflow into Chicago Drainage canal was not considered in making the computations. See under "Diversions."

No discharge measurements were made at this station during the year ending September 30, 1920.

*Discharge measurements of Des Plaines River at Lemont, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| | *Feet.* | *Sec.-ft.* |
| Mar. 17 | 6.42 | 5,500 |
| July 15 | 2.68 | 60 |

*Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 9 | 52 | 120 | 625 | 460 | 715 | 670 | 805 | 212 | 63 | 17 | 10 |
| 2 | 10 | 52 | 150 | 625 | 385 | 900 | 540 | 1,150 | 212 | 52 | 6 | 6 |
| 3 | 9 | 44 | 120 | 625 | 385 | 1,050 | 500 | 1,460 | 180 | 44 | 6 | 10 |
| 4 | 6 | 63 | 110 | 625 | 350 | 1,100 | 500 | 2,520 | 245 | 44 | 5 | 9 |
| 5 | 9 | 44 | 70 | 625 | 385 | 1,100 | 460 | 4,080 | 815 | 33 | 10 | 6 |
| 6 | 10 | 28 | 95 | 625 | 245 | 524 | 460 | 4,600 | 280 | 28 | 22 | 3 |
| 7 | 10 | 33 | 110 | 542 | 245 | 484 | 500 | 3,630 | 245 | 28 | 22 | 0 |
| 8 | 6 | 52 | 70 | 460 | 245 | 540 | 670 | 3,220 | 212 | 22 | 22 | 0 |
| 9 | 6 | 70 | 95 | 320 | 245 | 670 | 760 | 2,850 | 120 | 10 | 10 | 6 |
| 10 | 6 | 63 | 110 | 180 | 245 | 715 | 715 | 2,230 | 120 | 6 | 6 | 6 |
| 11 | 6 | 70 | 85 | 159 | 150 | 625 | 715 | 2,100 | 70 | 3 | 6 | 6 |
| 12 | 5 | 52 | 120 | 138 | 138 | 760 | 670 | 1,570 | 120 | 10 | 10 | 9 |
| 13 | 6 | 44 | 168 | 129 | 180 | 1,860 | 625 | 1,350 | 212 | 22 | 9 | 3 |
| 14 | 10 | 52 | 245 | 120 | 266 | 2,520 | 582 | 1,000 | 70 | 22 | 6 | 0 |
| 15 | 6 | 52 | 315 | 135 | 422 | 2,520 | 715 | 852 | 70 | 44 | 6 | 0 |
| 16 | 9 | 63 | 350 | 150 | 582 | 3,630 | 1,410 | 760 | 150 | 52 | 6 | 0 |
| 17 | 10 | 52 | 336 | 181 | 540 | 5,200 | 1,520 | 805 | 245 | 63 | 10 | 0 |
| 18 | 10 | 63 | 266 | 212 | 540 | 5,520 | 1,570 | 900 | 245 | 33 | 10 | 0 |
| 19 | 9 | 70 | 266 | 264 | 524 | 4,600 | 1,410 | 670 | 212 | 22 | 10 | 0 |
| 20 | 10 | 95 | 245 | 315 | 460 | 3,420 | 1,350 | 582 | 180 | 17 | 6 | 0 |
| 21 | 10 | 95 | 422 | 422 | 445 | 3,220 | 1,100 | 500 | 245 | 6 | 6 | 0 |
| 22 | 9 | 85 | 500 | 540 | 422 | 2,850 | 950 | 422 | 180 | 28 | 6 | 3 |
| 23 | 10 | 70 | 500 | 715 | 500 | 2,370 | 852 | 385 | 180 | 33 | 9 | 3 |
| 24 | 22 | 70 | 524 | 805 | 500 | 1,980 | 900 | 371 | 150 | 22 | 10 | 0 |
| 25 | 52 | 63 | 540 | 900 | 500 | 1,630 | 1,300 | 350 | 180 | 9 | 6 | 0 |
| 26 | 44 | 63 | 460 | 1,000 | 524 | 1,410 | 1,250 | 350 | 212 | 6 | 6 | 0 |
| 27 | 70 | 52 | 500 | 900 | 460 | 1,250 | 1,000 | 315 | 120 | 6 | 10 | 0 |
| 28 | 95 | 70 | 460 | 760 | 524 | 1,100 | 950 | 280 | 150 | 10 | 10 | 3 |
| 29 | 95 | 110 | 385 | 760 | ..... | 900 | 805 | 280 | 70 | 9 | 10 | 10 |
| 30 | 70 | 110 | 460 | 540 | ..... | 805 | 760 | 280 | 52 | 6 | 10 | 33 |
| 31 | 63 | ..... | 500 | 524 | ..... | 760 | ..... | 245 | ..... | 28 | 17 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 50 | 315 | 315 | | | | 2,370 | 1,630 | 70 | 50 | 20 | 20 |
| 2 | 62 | 460 | 422 | | | 50 | 2,230 | 1,360 | 70 | 50 | 20 | 20 |
| 3 | 70 | 715 | 582 | | | | 1,740 | 1,740 | 95 | 50 | 10 | 20 |
| 4 | 120 | 852 | 715 | | | 715 | 1,200 | 1,740 | 120 | 34 | 10 | 10 |
| 5 | 315 | 900 | | | | 1,200 | 1,100 | 1,200 | 150 | 34 | 3 | 10 |
| 6 | 212 | 950 | | | | 1,410 | 852 | 900 | 120 | 34 | 3 | 10 |
| 7 | 180 | 805 | | | | 1,460 | 805 | 760 | 95 | 50 | 3 | 20 |
| 8 | 180 | 760 | | | | 1,460 | 852 | 670 | 95 | 50 | 3 | 20 |
| 9 | 180 | 670 | | | | 1,520 | 1,050 | 460 | 95 | 50 | 3 | 20 |
| 10 | 245 | 950 | 700 | | | 1,520 | 1,100 | 422 | 70 | 34 | 3 | 34 |
| 11 | 315 | 852 | | | | 2,100 | 1,000 | 422 | 50 | 50 | 3 | 20 |
| 12 | 212 | 760 | | | | 3,030 | 805 | 422 | 50 | 50 | 3 | .5 |
| 13 | 150 | 582 | | | | 2,850 | 760 | 460 | 50 | 50 | 3 | .5 |
| 14 | 120 | 500 | | | | 3,220 | 625 | 422 | 95 | 70 | 3 | 10 |
| 15 | 120 | 460 | | | 45 | 2,680 | 582 | 385 | 150 | 95 | 3 | 20 |
| 16 | 120 | 460 | | 30 | | 2,850 | 582 | 385 | 315 | 70 | 3 | 20 |
| 17 | 95 | 500 | | | | 2,520 | 715 | 422 | 350 | 50 | 10 | 20 |
| 18 | 95 | 460 | 210 | | | 2,230 | 805 | 500 | 315 | 34 | 34 | 10 |
| 19 | 95 | 385 | | | | 1,980 | 760 | 500 | 245 | 34 | 20 | 10 |
| 20 | 95 | 315 | | | | 1,520 | 1,410 | 460 | 180 | 34 | 20 | 10 |
| 21 | 110 | 315 | | | | 1,250 | 1,980 | 422 | 180 | 34 | 34 | 10 |
| 22 | 70 | 280 | | | | 1,200 | 1,860 | 385 | 150 | 34 | 20 | 10 |
| 23 | 70 | 280 | | | | 1,150 | 1,630 | 385 | 95 | 34 | 10 | 3 |
| 24 | 70 | 245 | | | | 1,150 | 1,250 | 315 | 95 | 34 | 10 | 3 |
| 25 | 62 | 280 | | | | 2,370 | 1,000 | 245 | 70 | 20 | 3 | 10 |
| 26 | 50 | 245 | 70 | | | 4,080 | 900 | 180 | 50 | 20 | .5 | 10 |
| 27 | 50 | 212 | | | | 4,330 | 852 | 180 | 50 | 20 | 3 | 20 |
| 28 | 50 | 180 | | | | 3,850 | 900 | 120 | 34 | 20 | 10 | 20 |
| 29 | 70 | 180 | | | | 3,850 | 900 | 95 | 34 | 10 | 10 | 10 |
| 30 | 95 | 212 | | | ..... | 3,030 | 1,050 | 70 | 34 | 20 | 10 | 10 |
| 31 | 180 | ..... | | | ..... | 2,850 | ..... | 70 | ..... | 20 | 20 | ..... |

NOTE.—Gage not read, discharge interpolated Jan. 2, 5, 7, 9, 11, 13, 15, 17, and 19, 1919. Zero flow, which occurred on several days during September, 1919, was caused by closing of gates at dam at Riverside after flushing the pond back of dam. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Des Plaines River at Lemont, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 705 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 95 | 5 | 22.6 | 0.032 | 0.04 |
| November | 110 | 33 | 63.4 | .090 | .10 |
| December | 540 | 70 | 281 | .399 | .46 |
| January | 1,000 | 120 | 481 | .682 | .79 |
| February | 582 | 138 | 388 | .550 | .57 |
| March | 5,520 | 484 | 1,830 | ..... | ..... |
| April | 1,570 | 460 | 874 | 1.24 | 1.38 |
| May | 4,600 | 245 | 1,320 | ..... | ..... |
| June | 315 | 52 | 175 | .248 | .28 |
| July | 63 | 3 | 25.2 | .036 | .04 |
| August | 22 | 5 | 9.8 | .014 | .02 |
| September | 33 | 0 | 4.2 | .006 | .01 |
| The year | 5,520 | 0 | 459 | ..... | ..... |
| 1919–20. | | | | | |
| October | 315 | 50 | 126 | .179 | .21 |
| November | 950 | 180 | 503 | .713 | .80 |
| December | ..... | ..... | 373 | .529 | .61 |
| January | ..... | ..... | 30.0 | .043 | .05 |
| February | ..... | ..... | 45.0 | .064 | .07 |
| March | 4,330 | 50 | 2,050 | ..... | ..... |
| April | 2,370 | 582 | 1,120 | 1.59 | 1.77 |
| May | 1,860 | 70 | 588 | .834 | .96 |
| June | 350 | 34 | 119 | .169 | .19 |
| July | 95 | 10 | 40.0 | .057 | .07 |
| August | 34 | .5 | 10.0 | .014 | .02 |
| September | 34 | .5 | 13.7 | .019 | .02 |
| The year | 4,330 | .5 | 420 | ..... | ..... |

NOTE.—Discharge in second-feet per square mile and run-off in inches not computed for March and May, 1919, and March, 1920, on account of overflow into Chicago Drainage canal at Willow Springs.

### DES PLAINES RIVER AT JOLIET, ILL.

LOCATION.—In NE. ¼ sec. 9, T. 35 N., R. 10 E., at Jackson Street bridge, Joliet, Will County, 1,200 feet upstream from Cass Street bridge.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—December 4, 1914, to September 30, 1920; from Cass Street bridge, September 5 to December 19, 1914.

GAGE.—Gurley 7-day water-stage recorder installed December 3, 1914. Chain gage attached to upstream side of Cass Street bridge used September 5 to December 19, 1914.

DISCHARGE MEASUREMENTS.—Made from upstream side of Cass Street bridge.

CHANNEL AND CONTROL.—Channel excavated in solid rock, with a concrete wall on either side; permanent.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during days of record for the year ending September 30, 1919, 18,400 second-feet, March 18; minimum mean daily discharge, 7,220 second-feet, September 7.

Maximum mean daily discharge during days of record for the year ending September 30, 1920, 14,800 second-feet, March 26; minimum mean daily discharge, 6,280 second-feet, November 30.

1914–1920: Maximum mean daily discharge during days of record, 18,400 second-feet, March 18, 1919; minimum mean daily discharge, 5,420 second-feet, April 25, 1915.

DIVERSIONS.—Water is diverted to the Illinois & Michigan canal at dam No. 1, about 100 feet above gage.

REGULATION.—Flow past the gage is largely regulated by operation of power plant of Chicago Sanitary District at Lockport, which utilizes the flow of Chicago Drainage canal and, to a lesser extent, by operation of Economy Light & Power Co.'s plant, about 100 feet above gage.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined. Operation of the water-stage recorder satisfactory except as indicated in footnote to tables of daily discharge. Daily discharge ascertained by use of discharge integrator, except for days when water-stage recorder was not operating satisfactorily. Records excellent.

*Discharge measurements of Des Plaines River at Joliet, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| May 6 | 7.40 | 15,900 | May 7 | 7.52 | 16,200 | June 17 | | [a]464 |
| 6 | | [a]508 | June 17 | 4.58 | 8,140 | | | |

[a] Flow measured in Illinois & Michigan canal.

*Daily discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 8,330 | 9,320 | 8,160 | 8,360 | 8,400 | [a]9,700 | 8,980 | 9,700 | 8,230 | 8,680 | 8,490 | 8,300 |
| 2 | 8,400 | 8,320 | 9,330 | 8,910 | 7,260 | 9,680 | 8,560 | 9,590 | 9,200 | 8,980 | 8,380 | 7,990 |
| 3 | 8,640 | 8,610 | 9,250 | 8,710 | 8,770 | 10,400 | 8,600 | 12,600 | 9,260 | 8,930 | 7,900 | 8,440 |
| 4 | 8,830 | 9,210 | 9,240 | 8,260 | 9,120 | 11,200 | 8,770 | 14,700 | 9,050 | 7,920 | 7,960 | 8,760 |
| 5 | 8,580 | 9,500 | 9,110 | 7,960 | 8,470 | 9,570 | 7,620 | 17,400 | 9,400 | 8,360 | 8,410 | 8,940 |
| 6 | 9,680 | 9,480 | 9,200 | 9,100 | 8,190 | 9,940 | 7,680 | 17,600 | 9,390 | 8,440 | 8,640 | 8,440 |
| 7 | [a]9,200 | 8,760 | 8,370 | 8,580 | 8,260 | 9,820 | 8,380 | 15,600 | 8,310 | 8,760 | 8,480 | 7,220 |
| 8 | [a]9,100 | 9,580 | 8,280 | 8,340 | 7,660 | 9,010 | 8,760 | 14,200 | 7,830 | 8,120 | 8,240 | 8,090 |
| 9 | 9,070 | 8,940 | 9,340 | 8,100 | 7,380 | 7,910 | 9,030 | 13,300 | 8,060 | 7,730 | 8,020 | 8,240 |
| 10 | 9,110 | 8,580 | 9,360 | 8,360 | 8,030 | 8,200 | 8,800 | 12,400 | 7,900 | 7,960 | 8,190 | 8,110 |
| 11 | 9,100 | 8,050 | 9,140 | 8,730 | 8,200 | 9,150 | 8,390 | 11,200 | 8,160 | 8,800 | 8,570 | [a]8,200 |
| 12 | [a]9,100 | 8,920 | 9,180 | 7,660 | 7,840 | 9,420 | 8,690 | 11,600 | 9,700 | 7,880 | 8,310 | [a]8,200 |
| 13 | [a]8,070 | 8,670 | 9,390 | 8,680 | 7,900 | 9,680 | 7,980 | 10,900 | 9,320 | 8,070 | 8,720 | [a]8,200 |
| 14 | [a]8,900 | 8,100 | 9,100 | 8,710 | 7,800 | 11,400 | 9,360 | 10,200 | 8,180 | 9,320 | 8,680 | 8,040 |
| 15 | 8,750 | 8,420 | 7,780 | 8,240 | 8,100 | 11,800 | 9,320 | 9,880 | 8,360 | 8,100 | 8,640 | 7,820 |
| 16 | 8,160 | 8,320 | 9,320 | 7,950 | | 13,500 | 9,940 | 10,300 | 8,250 | 9,330 | 8,660 | 8,280 |
| 17 | 8,940 | 8,030 | 9,100 | 8,170 | | 18,000 | 10,400 | 9,420 | 8,510 | 8,200 | 8,800 | 8,390 |
| 18 | 8,720 | 8,600 | 9,540 | 8,140 | | 18,400 | 10,400 | 8,890 | 8,380 | 7,960 | 8,770 | 8,940 |
| 19 | 8,940 | 9,240 | 9,200 | 7,570 | [a]8,500 | 16,500 | 9,600 | 10,200 | 8,480 | 9,400 | 8,740 | 9,000 |
| 20 | 7,800 | 9,460 | 9,040 | 8,920 | | 14,500 | 8,930 | 9,810 | 9,070 | 8,320 | 8,730 | 7,940 |
| 21 | 8,830 | 8,990 | 8,920 | 8,750 | | 13,600 | 9,770 | 9,760 | 8,440 | 8,820 | 8,400 | 7,880 |
| 22 | 8,490 | 9,000 | 9,050 | 8,900 | 8,450 | 12,000 | 9,840 | 9,580 | 8,530 | 8,480 | 8,520 | 8,140 |
| 23 | 8,300 | 8,560 | 10,200 | 9,120 | 9,040 | 10,600 | 9,580 | 9,480 | 9,110 | 8,560 | 8,460 | 8,360 |
| 24 | 8,760 | 7,940 | 9,130 | 9,220 | 9,650 | 9,990 | 9,470 | 8,660 | 8,830 | 8,160 | 8,660 | 8,300 |
| 25 | 8,320 | 9,400 | 8,660 | 9,070 | 9,750 | 9,470 | 9,660 | 8,780 | 8,740 | 8,780 | 8,350 | 8,280 |
| 26 | 8,980 | 8,850 | 8,250 | 7,840 | 9,640 | 9,330 | [a]9,500 | 9,590 | 9,200 | 8,290 | 8,240 | 8,550 |
| 27 | 8,690 | 9,040 | 8,840 | [a]9,200 | 9,620 | 9,080 | 8,200 | 9,300 | 9,100 | 7,850 | | 7,480 |
| 28 | 8,880 | 7,520 | 8,270 | 9,180 | [a]9,600 | 9,020 | 9,610 | 9,420 | 8,840 | 8,840 | [a]8,400 | 7,260 |
| 29 | 9,150 | 8,920 | 8,290 | 9,280 | | [a]9,500 | 9,390 | 9,330 | 8,440 | 8,680 | | 8,140 |
| 30 | 9,220 | 8,670 | 8,870 | 9,010 | | 8,240 | 9,240 | 8,500 | 8,990 | 8,070 | | 8,500 |
| 31 | 9,400 | | 9,080 | 8,750 | | 9,330 | | 7,680 | | 8,400 | 8,200 | |

*Daily discharge, in second-feet, of Des Plaines River at Joliet, Ill, for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | | | | |
| 1 | 8,600 | b9,200 | 8,780 | 6,920 | 7,320 | 8,970 | 12,000 | 9,380 | 7,920 | 8,160 | 7,710 | 8,650 |
| 2 | 8,480 | | 8,140 | 8,780 | 8,770 | 8,540 | 11,500 | 9,540 | 7,810 | 7,650 | 8,420 | 8,820 |
| 3 | 8,280 | | | 8,160 | 9,350 | 8,230 | 9,200 | 9,840 | 7,920 | 7,580 | 9,220 | 8,540 |
| 4 | 7,580 | | | 7,340 | 9,320 | 9,800 | 8,840 | 9,540 | b7,500 | 7,540 | 8,620 | 8,040 |
| 5 | 9,340 | a8,800 | a8,000 | 9,300 | 9,490 | 9,500 | 9,090 | 8,980 | b8,600 | 7,640 | 8,050 | 7,420 |
| 6 | 8,620 | | | 8,920 | b9,500 | 9,350 | 9,310 | 8,640 | 8,510 | 7,960 | 8,140 | 7,680 |
| 7 | 8,830 | | 7,080 | 8,350 | b9,500 | 7,750 | 9,060 | 8,330 | 7,820 | 8,380 | 7,920 | 8,660 |
| 8 | 8,500 | b8,510 | 7,790 | 8,880 | b7,580 | | 8,920 | 7,700 | 7,910 | 8,040 | 6,910 | 8,830 |
| 9 | 8,780 | 8,220 | a8,200 | 9,100 | 9,340 | | 9,170 | 6,990 | 8,370 | 8,300 | 8,180 | 9,140 |
| 10 | 9,260 | 9,740 | a8,200 | 8,490 | 9,280 | a10500 | 8,440 | 7,640 | 7,490 | | 8,120 | 8,770 |
| 11 | 9,220 | 9,760 | 8,790 | 7,550 | 8,940 | | 7,850 | 8,000 | 8,480 | a8,300 | 8,240 | 7,920 |
| 12 | 8,040 | 9,930 | 8,220 | 9,400 | 9,020 | 12,200 | 9,080 | 8,440 | 7,860 | | 8,520 | 7,150 |
| 13 | 8,560 | 9,180 | 8,160 | 8,640 | 8,560 | 10,200 | 9,610 | 8,440 | 8,200 | b8,500 | 8,480 | 8,570 |
| 14 | 8,940 | 9,080 | 6,850 | 8,540 | 8,960 | 9,550 | 8,880 | 8,370 | 7,910 | 8,530 | 9,160 | |
| 15 | 8,720 | 8,820 | 8,220 | 9,320 | b7,500 | 11,200 | 8,800 | b7,200 | 8,350 | 8,350 | 7,730 | a8,400 |
| 16 | 8,840 | 7,570 | 8,040 | 9,420 | b8,300 | 11,500 | 9,000 | | 8,170 | 8,980 | 8,240 | |
| 17 | 8,900 | 9,260 | 7,550 | 8,560 | b8,550 | 11,000 | b8,750 | a8,000 | 8,380 | 8,540 | 8,780 | |
| 18 | 8,180 | 9,490 | 8,060 | 7,120 | 8,670 | 11,600 | b8,500 | | 8,140 | 8,320 | 8,710 | b7,700 |
| 19 | 7,780 | 9,540 | 8,220 | 9,000 | 8,680 | 11,300 | b9,200 | 8,530 | 7,500 | 7,850 | 8,600 | 7,720 |
| 20 | 8,660 | 9,110 | 7,650 | 9,240 | 9,240 | 9,890 | b9,400 | 8,560 | 8,450 | 8,340 | 8,610 | 8,660 |
| 21 | 8,390 | 9,500 | 6,500 | 8,760 | 9,180 | 8,400 | b9,700 | 8,460 | 7,740 | 8,530 | 7,780 | 8,630 |
| 22 | 8,580 | 9,100 | 8,570 | 9,000 | 7,120 | 9,980 | 10,300 | 7,640 | 7,480 | 8,780 | 7,900 | 8,600 |
| 23 | 8,340 | 6,930 | 8,440 | 8,820 | 9,100 | 9,820 | 9,720 | 7,580 | 8,210 | 8,640 | 8,430 | 8,740 |
| 24 | 8,720 | 9,310 | 7,560 | b8,600 | 9,290 | 9,220 | b8,800 | 7,940 | 8,060 | 8,100 | 8,720 | 8,300 |
| 25 | 8,120 | 8,420 | b6,500 | a7,500 | 8,900 | 12,100 | 8,470 | 8,210 | 8,070 | 7,640 | 8,580 | b7,300 |
| 26 | 8,000 | 8,600 | a7,500 | 8,960 | 8,790 | 14,800 | 9,320 | 9,640 | 8,260 | 8,060 | 8,410 | 7,390 |
| 27 | 8,660 | 6,860 | b8,000 | 9,040 | b8,750 | 12,960 | 9,640 | 9,140 | 6,940 | 8,340 | 8,770 | 8,460 |
| 28 | 8,860 | 9,200 | 6,960 | 9,320 | a8,700 | 13,400 | 9,300 | b8,100 | 7,740 | 8,550 | 7,990 | 8,890 |
| 29 | 9,140 | 8,070 | 8,720 | 9,360 | b6,800 | 14,100 | 9,060 | b7,300 | 9,020 | 8,320 | 7,920 | 8,990 |
| 30 | 8,810 | 6,280 | 8,560 | a8,700 | ..... | 12,600 | 9,110 | 7,220 | 8,800 | 8,880 | 8,420 | 9,320 |
| 31 | 9,020 | ..... | 8,520 | b8,100 | ..... | 12,000 | ..... | 6,960 | ..... | 8,100 | 8,660 | ..... |

a No record; discharge estimated.
b Discharge partly estimated because of incomplete gage-height record.

NOTE.—Daily discharge in the above tables does not include the flow in the Illinois and Michigan canal. (See "Diversions" in station description.) Braced figures show mean discharge for periods indicated.

*Monthly discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Month. | 1918-19. | | | 1919-20. | | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Maximum. | Minimum. | Mean. |
| October | 9,680 | 7,800 | 8,790 | 9,340 | 7,580 | 8,660 |
| November | 9,580 | 7,520 | 8,770 | 9,930 | 6,280 | 8,750 |
| December | 10,200 | 7,780 | 8,970 | 8,790 | 6,500 | 7,930 |
| January | 9,280 | 7,570 | 8,570 | 9,420 | 6,920 | 8,620 |
| February | 9,750 | 7,260 | 8,500 | 9,500 | 6,800 | 8,710 |
| March | 18,400 | 7,910 | 10,900 | 14,800 | 7,750 | 10,700 |
| April | 10,400 | 7,620 | 9,080 | 12,000 | 7,850 | 9,270 |
| May | 17,600 | 7,680 | 11,000 | 9,840 | 6,960 | 8,270 |
| June | 9,700 | 7,830 | 8,710 | 9,020 | 6,940 | 8,060 |
| July | 9,400 | 7,730 | 8,460 | 8,980 | 7,540 | 8,240 |
| August | 8,800 | 7,900 | 8,440 | 9,220 | 6,910 | 8,320 |
| September | 9,000 | 7,220 | 8,210 | 9,320 | 7,150 | 8,350 |
| The year | 18,400 | 7,220 | 9,040 | 14,800 | 6,280 | 8,650 |

### FOX RIVER AT ALGONQUIN, ILL.

LOCATION.—In NW. ¼ sec. 34, T. 43 N., R. 8 E. third principal meridian, at Chicago Street bridge in Algonquin, McHenry County, 100 feet above Public Service Co.'s dam, and 500 feet above Crystal Lake outlet.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1920.

DRAINAGE AREA.—1,340 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

GAGE.—Enamel staff gage attached to concrete abutment of bridge; read by Edward Pedersen.

CHANNEL AND CONTROL.—Control is a concrete dam about 100 feet below gage; repaired during August, 1919; practically permanent.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading below dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.0 feet at 5.30 p. m. March 21 (discharge, 4,800 second-feet); minimum discharge, 117 second-feet August 22.

Maximum stage recorded during year ending September 30, 1920, 4.2 feet at 7 a. m. and 6 p. m. March 30 (discharge, 5,050 second-feet); minimum stage, 1.02 feet June 13 (discharge, 215 second-feet).

1916–1920: Maximum stage recorded, 5.3 feet March 31, 1916 (discharge, 7,120 second-feet); minimum stage, 0.59 foot August 31, 1918 (discharge, 67 second-feet).

REGULATION.—Water is diverted at dam below gage to operate a grist mill, which runs on an average of about 4 hours a day, except Sundays, during September to March, inclusive, and one day a week during the remainder of year. Effect of operation is appreciable at gage at low stages only and mill headgates are closed when gage readings or discharge measurements are made.

ACCURACY.—Stage-discharge relation changed by repairs to dam during August, 1919; temporarily changed during repairs to mill during later part of July, 1919; not affected by ice. Three fairly well defined rating curves used, applicable respectively, October 1, 1918, to July 14, 1919; July 15 to August 3, 1919, and August 18, 1919, to September 30, 1920. Gage read to hundredths twice daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records good except those obtained during repairs to mill and dam, which are fair.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Fox River at Algonquin, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Apr. 16 | 2.18 | 1,640 | July 16 | 1.07 | 311 | Sept. 3 | 0.98 | 201 |
| July 16 | 1.06 | 296 | Sept. 3 | .98 | 202 | | | |

*Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1918–19.** | | | | | | | | | | | | |
| 1 | 185 | 326 | 295 | 507 | 588 | 750 | 2,390 | 1,540 | 422 | 365 | 210 | 174 |
| 2 | 185 | 342 | 295 | 490 | 579 | 750 | 2,070 | 1,610 | 406 | 357 | 235 | 174 |
| 3 | 178 | 357 | 310 | 472 | 579 | 800 | 1,910 | 1,840 | 389 | 357 | 258 | 174 |
| 4 | 178 | 357 | 310 | 455 | 579 | 800 | 1,760 | 2,070 | 373 | 350 | 251 | 168 |
| 5 | 178 | 342 | 326 | 439 | 560 | 850 | 1,610 | 2,560 | 381 | 342 | 244 | 168 |
| 6 | 172 | 326 | 342 | 422 | 560 | 905 | 1,540 | 2,730 | 373 | 342 | 236 | 168 |
| 7 | 172 | 310 | 357 | 406 | 542 | 905 | 1,540 | 2,730 | 373 | 334 | 229 | 174 |
| 8 | 172 | 302 | 357 | 389 | 525 | 960 | 1,470 | 2,560 | 381 | 326 | 222 | 174 |
| 9 | 172 | 310 | 373 | 381 | 507 | 1,020 | 1,260 | 2,560 | 389 | 326 | 214 | 180 |
| 10 | 178 | 310 | 397 | 373 | 490 | 1,080 | 1,200 | 2,390 | 406 | 318 | 207 | 187 |
| 11 | 185 | 318 | 439 | 365 | 472 | 1,140 | 1,200 | 2,230 | 422 | 310 | 200 | 187 |
| 12 | 185 | 318 | 507 | 365 | 472 | 1,260 | 1,260 | 2,230 | 439 | 295 | 192 | 194 |
| 13 | 172 | 318 | 569 | 365 | 490 | 1,470 | 1,260 | 2,070 | 464 | 1,260 | 185 | 194 |
| 14 | 162 | 326 | 606 | 357 | 507 | 1,760 | 1,400 | 1,910 | 498 | 750 | 178 | 200 |
| 15 | 151 | 326 | 597 | 357 | 525 | 2,070 | 1,470 | 1,840 | 534 | 288 | 170 | 200 |
| 16 | 151 | 334 | 579 | 357 | 542 | 2,390 | 1,610 | 1,760 | 560 | 288 | 163 | 208 |
| 17 | 162 | 342 | 560 | 350 | 560 | 2,910 | 1,540 | 1,680 | 579 | 272 | 156 | 215 |
| 18 | 167 | 350 | 542 | 350 | 588 | 3,630 | 1,540 | 1,610 | 597 | 272 | 148 | 222 |
| 19 | 172 | 357 | 534 | 365 | 625 | 4,010 | 1,540 | 1,470 | 597 | 258 | 135 | 230 |
| 20 | 185 | 357 | 542 | 397 | 653 | 4,400 | 1,540 | 1,400 | 579 | 258 | 123 | 238 |
| 21 | 197 | 350 | 560 | 430 | 702 | 4,800 | 1,540 | 1,260 | 551 | 250 | 123 | 245 |
| 22 | 210 | 342 | 569 | 464 | 750 | 4,800 | 1,610 | 1,200 | 516 | 242 | 117 | 252 |
| 23 | 216 | 334 | 579 | 498 | 800 | 4,600 | 1,610 | 1,080 | 490 | 229 | 123 | 260 |
| 24 | 222 | 326 | 579 | 534 | 800 | 4,200 | 1,680 | 960 | 472 | 216 | 154 | 268 |
| 25 | 229 | 318 | 569 | 569 | 800 | 4,010 | 1,760 | 905 | 455 | 204 | 168 | 275 |
| 26 | 235 | 310 | 560 | 597 | 800 | 3,820 | 1,680 | 800 | 439 | 191 | 174 | 291 |
| 27 | 250 | 310 | 560 | 616 | 750 | 3,630 | 1,610 | 702 | 422 | 178 | 180 | 307 |
| 28 | 265 | 302 | 551 | 616 | 750 | 3,270 | 1,610 | 634 | 406 | 167 | 187 | 339 |
| 29 | 280 | 302 | 542 | 597 | ..... | 2,910 | 1,540 | 560 | 389 | 156 | 187 | 409 |
| 30 | 295 | 295 | 542 | 597 | ..... | 2,730 | 1,540 | 490 | 373 | 162 | 180 | 483 |
| 31 | 310 | ..... | 525 | 588 | ..... | 2,560 | ..... | 447 | ..... | 185 | 174 | ..... |
| **1919–20.** | | | | | | | | | | | | |
| 1 | 580 | 920 | 805 | 502 | 355 | 409 | 4,850 | 1,650 | 483 | 464 | 291 | 245 |
| 2 | 640 | 1,160 | 805 | 502 | 347 | 409 | 4,850 | 1,650 | 454 | 445 | 283 | 252 |
| 3 | 750 | 1,440 | 750 | 483 | 339 | 427 | 4,850 | 1,580 | 418 | 436 | 283 | 252 |
| 4 | 920 | 1,510 | 750 | 483 | 339 | 445 | 4,850 | 1,580 | 382 | 427 | 275 | 260 |
| 5 | 980 | 1,580 | 750 | 464 | 339 | 464 | 4,850 | 1,510 | 347 | 427 | 268 | 260 |
| 6 | 1,100 | 1,510 | 750 | 454 | 347 | 492 | 4,850 | 1,440 | 323 | 427 | 260 | 268 |
| 7 | 1,100 | 1,510 | 805 | 445 | 355 | 530 | 4,650 | 1,370 | 307 | 409 | 260 | 275 |
| 8 | 1,100 | 1,510 | 805 | 427 | 355 | 570 | 4,650 | 1,230 | 291 | 409 | 260 | 275 |
| 9 | 1,040 | 1,510 | 805 | 427 | 355 | 610 | 4,650 | 1,100 | 275 | 391 | 268 | 283 |
| 10 | 980 | 1,510 | 805 | 418 | 355 | 640 | 4,650 | 860 | 260 | 391 | 268 | 275 |
| 11 | 980 | 1,510 | 805 | 427 | 364 | 750 | 4,650 | 805 | 245 | 382 | 268 | 275 |
| 12 | 980 | 1,580 | 750 | 427 | 364 | 920 | 4,450 | 860 | 230 | 373 | 275 | 268 |
| 13 | 920 | 1,580 | 750 | 436 | 373 | 1,230 | 4,050 | 920 | 215 | 373 | 275 | 268 |
| 14 | 920 | 1,650 | 750 | 427 | 373 | 1,580 | 3,470 | 920 | 238 | 364 | 275 | 260 |
| 15 | 920 | 1,650 | 750 | 409 | 373 | 2,100 | 3,100 | 920 | 275 | 355 | 268 | 260 |
| 16 | 920 | 1,650 | 695 | 391 | 382 | 2,920 | 2,750 | 860 | 291 | 355 | 268 | 260 |
| 17 | 860 | 1,580 | 695 | 373 | 382 | 3,850 | 2,420 | 750 | 307 | 355 | 260 | 268 |
| 18 | 860 | 1,510 | 695 | 364 | 391 | 4,250 | 2,100 | 695 | 291 | 347 | 260 | 275 |
| 19 | 805 | 1,440 | 640 | 355 | 391 | 4,450 | 1,800 | 695 | 315 | 339 | 260 | 275 |
| 20 | 805 | 1,440 | 640 | 355 | 400 | 4,450 | 1,650 | 640 | 347 | 339 | 268 | 283 |
| 21 | 750 | 1,370 | 620 | 364 | 409 | 4,250 | 1,580 | 640 | 382 | 339 | 268 | 283 |
| 22 | 695 | 1,300 | 600 | 364 | 409 | 4,050 | 1,580 | 620 | 418 | 331 | 275 | 291 |
| 23 | 640 | 1,230 | 600 | 373 | 427 | 3,850 | 1,580 | 610 | 454 | 331 | 275 | 291 |
| 24 | 640 | 1,160 | 580 | 373 | 445 | 3,660 | 1,580 | 620 | 483 | 323 | 275 | 283 |
| 25 | 630 | 1,100 | 580 | 382 | 436 | 3,850 | 1,580 | 620 | 464 | 323 | 268 | 275 |
| 26 | 620 | 1,040 | 560 | 391 | 427 | 4,250 | 1,580 | 600 | 445 | 323 | 260 | 275 |
| 27 | 620 | 980 | 560 | 391 | 427 | 4,650 | 1,580 | 580 | 427 | 315 | 260 | 275 |
| 28 | 620 | 920 | 540 | 391 | 418 | 4,850 | 1,580 | 560 | 409 | 307 | 260 | 268 |
| 29 | 610 | 920 | 540 | 373 | 409 | 4,850 | 1,580 | 540 | 427 | 307 | 252 | 268 |
| 30 | 640 | 860 | 521 | 373 | ..... | 5,050 | 1,650 | 521 | 445 | 299 | 245 | 275 |
| 31 | 750 | ..... | 521 | 355 | ..... | 4,850 | ..... | 502 | ..... | 291 | 245 | ..... |

NOTE.—Mill headgates wide open during period Aug. 4–17, 1919; discharge interpolated. Gage not read, Feb. 8, 10, 12, and 14, 1920; discharge estimated.

*Monthly discharge of Fox River at Algonquin, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,340 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| **1918–19.** | | | | | |
| October | 310 | 151 | 199 | 0.149 | 0.17 |
| November | 357 | 295 | 327 | .244 | .27 |
| December | 606 | 295 | 483 | .360 | .42 |
| January | 616 | 350 | 454 | .339 | .39 |
| February | 800 | 472 | 611 | .456 | .47 |
| March | 4,800 | 750 | 2,430 | 1.81 | 2.09 |
| April | 2,390 | 1,200 | 1,580 | 1.18 | 1.32 |
| May | 2,730 | 447 | 1,610 | 1.20 | 1.38 |
| June | 597 | 373 | 456 | .340 | .38 |
| July | 1,260 | 156 | 318 | .237 | .27 |
| August | 258 | 117 | 185 | .138 | .16 |
| September | 483 | 168 | 232 | .173 | .19 |
| The year | 4,800 | 117 | 741 | .553 | 7.51 |
| **1919–20.** | | | | | |
| October | 1,100 | 580 | 819 | .611 | .70 |
| November | 1,650 | 860 | 1,350 | 1.01 | 1.13 |
| December | 805 | 521 | 685 | .511 | .59 |
| January | 502 | 355 | 410 | .306 | .35 |
| February | 445 | 339 | 382 | .285 | .31 |
| March | 5,050 | 409 | 2,570 | 1.92 | 2.21 |
| April | 4,850 | 1,580 | 3,130 | 2.34 | 2.61 |
| May | 1,650 | 502 | 918 | .685 | .79 |
| June | 483 | 215 | 355 | .265 | .30 |
| July | 464 | 291 | 364 | .272 | .31 |
| August | 291 | 245 | 267 | .199 | .23 |
| September | 291 | 245 | 271 | .202 | .23 |
| The year | 5,050 | 215 | 960 | .716 | 9.76 |

**FOX RIVER AT WEDRON, ILL.**

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge in Wedron, La Salle County, 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by O. E. Kirby.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed at measuring section is soft and probably shifts. Control, about 1,000 feet downstream, composed of coarse gravel and large boulders; seldom shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 13.55 feet at 7 a. m. March 18 (discharge, 16,000 second-feet); minimum stage, 5.40 feet at 5.30 p. m. October 1 (discharge, 156 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.2 feet at 6 a. m. March 26 (discharge, 17,900 second-feet); minimum stage, 5.62 feet at 6 p. m. September 21 (discharge, 246 second-feet).

1915–1920: Maximum stage recorded, 15.4 feet February 3, 1916 (discharge not determined because of backwater from ice); maximum open-water discharge recorded, 17,900 second-feet March 26, 1920; minimum discharge recorded, 105 second-feet, November 20, 1914 (measured by current meter).

REGULATION.—Slight diurnal fluctuation is caused by operation of power plants at and above Aurora.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined above and fairly well defined below 1,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods January 2–24, February 8–12, 1919, and December 10, 1919, to March 3, 1920, during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by means of gage heights, observer's notes, and weather records. Open-water records good; winter records poor.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Fox River at Wedron, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| | *Feet.* | *Sec.-ft.* |
| Apr. 30 | 8.15 | 2,600 |
| Aug. 5 | 5.65 | 260 |

*Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 176 | 600 | 1,040 | 1,220 | 1,410 | 1,220 | 3,760 | 2,610 | 1,130 | 635 | 385 | 282 |
| 2 | 282 | 500 | 532 | | 1,820 | 1,710 | 3,580 | 2,610 | 1,220 | 635 | 412 | 229 |
| 3 | 358 | 635 | 635 | | 1,220 | 2,190 | 3,070 | 4,130 | 1,310 | 565 | 385 | 229 |
| 4 | 331 | 440 | 710 | | 1,130 | 2,910 | 2,910 | 10,700 | 1,220 | 532 | 331 | 246 |
| 5 | 358 | 600 | 470 | | 1,040 | 2,610 | 2,610 | 11,900 | 1,220 | 470 | 255 | 385 |
| 6 | 331 | 532 | 470 | 1,220 | 1,130 | 2,060 | 2,470 | 8,000 | 1,130 | 385 | 306 | 331 |
| 7 | 306 | 532 | 440 | | 870 | 1,820 | 2,470 | 7,740 | 1,130 | 500 | 385 | 385 |
| 8 | 229 | 1,040 | 440 | | | 1,940 | 2,470 | 6,980 | 1,040 | 382 | 385 | 306 |
| 9 | 273 | 995 | 470 | | | 1,940 | 2,470 | 6,040 | 910 | 635 | 358 | 229 |
| 10 | 358 | 950 | 635 | | 820 | 1,940 | 2,470 | 5,590 | 950 | 532 | 331 | 260 |
| 11 | 385 | 750 | 910 | | | 2,910 | 2,330 | 4,940 | 910 | 532 | 331 | 321 |
| 12 | 358 | 565 | 870 | | | 4,520 | 1,820 | 4,320 | 1,130 | 500 | 306 | 331 |
| 13 | 321 | 830 | 1,040 | | 995 | 5,150 | 2,060 | 3,940 | 1,130 | 1,040 | 440 | 282 |
| 14 | 321 | 750 | 1,510 | | 950 | 5,590 | 2,330 | 3,580 | 1,040 | 750 | 385 | 331 |
| 15 | 246 | 635 | 1,610 | | 1,040 | 6,980 | 3,400 | 3,400 | 1,130 | 635 | 440 | 273 |
| 16 | 358 | 600 | 1,310 | 890 | 1,310 | 14,000 | 3,580 | 3,230 | 910 | 710 | 440 | 216 |
| 17 | 385 | 635 | 1,220 | | 950 | 14,600 | 3,400 | 3,230 | 950 | 565 | 358 | 385 |
| 18 | 358 | 532 | 1,130 | | 1,310 | 14,900 | 3,230 | 2,910 | 870 | 500 | 385 | 365 |
| 19 | 358 | 470 | 1,130 | | 1,130 | 10,200 | 3,070 | 2,760 | 910 | 470 | 385 | 331 |
| 20 | 385 | 500 | 1,130 | | 1,310 | 8,800 | 2,610 | 2,610 | 910 | 470 | 306 | 440 |
| 21 | 302 | 470 | 1,220 | | 1,310 | 8,530 | 2,610 | 2,470 | 870 | 412 | 306 | 358 |
| 22 | 212 | 385 | 1,220 | | 1,410 | 8,000 | 2,470 | 2,190 | 830 | 358 | 292 | 331 |
| 23 | 500 | 600 | 1,510 | 1,420 | 1,220 | 7,480 | 2,330 | 2,060 | 750 | 385 | 385 | 321 |
| 24 | 672 | 565 | 1,220 | | 1,310 | 6,980 | 2,610 | 1,940 | 870 | 440 | 440 | 565 |
| 25 | 672 | 600 | 1,310 | 1,940 | 1,510 | 6,500 | 2,610 | 1,710 | 830 | 440 | 440 | 440 |
| 26 | 532 | 635 | 1,310 | 2,060 | 1,310 | 6,270 | 2,610 | 1,610 | 870 | 440 | 282 | 385 |
| 27 | 672 | 635 | 1,410 | 1,510 | 1,310 | 5,810 | 2,470 | 1,610 | 750 | 385 | 260 | 358 |
| 28 | 672 | 635 | 1,310 | 1,610 | 1,220 | 5,590 | 2,760 | 1,410 | 672 | 331 | 292 | 385 |
| 29 | 830 | 750 | 1,130 | 1,410 | ..... | 4,940 | 2,910 | 1,220 | 635 | 268 | 385 | 331 |
| 30 | 790 | 790 | 1,130 | 1,410 | ..... | 4,520 | 2,610 | 1,130 | 565 | 268 | 358 | 710 |
| 31 | 790 | ..... | 1,510 | 1,410 | ..... | 4,130 | ..... | 1,040 | ..... | 358 | 306 | ..... |

*Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | | | | |
| 1 | 1,510 | 1,610 | 1,610 | | | 800 | 7,230 | 5,810 | 1,040 | 750 | 440 | 440 |
| 2 | 1,310 | 1,710 | 1,710 | | | 950 | 6,980 | 4,520 | 1,040 | 710 | 385 | 565 |
| 3 | 1,130 | 1,710 | 950 | | | 1,400 | 6,270 | 3,760 | 1,040 | 672 | 311 | 440 |
| 4 | 995 | 1,940 | 1,820 | | | 6,270 | 5,810 | 3,400 | 950 | 635 | 311 | 412 |
| 5 | 1,940 | 1,940 | 1,940 | | | 6,740 | 5,590 | 3,070 | 870 | 532 | 500 | 385 |
| 6 | 1,610 | 2,060 | 1,510 | | | 3,580 | 5,810 | 2,760 | 635 | 672 | 470 | 412 |
| 7 | 1,610 | 2,190 | 1,610 | | | 3,070 | 5,590 | 2,470 | 635 | 750 | 470 | 412 |
| 8 | 1,510 | 2,330 | 1,510 | | | 2,190 | 5,370 | 2,330 | 672 | 750 | 500 | 532 |
| 9 | 1,610 | 2,330 | 1,710 | | | 2,190 | 5,150 | 1,940 | 710 | 635 | 500 | 635 |
| 10 | 3,230 | 2,610 | | | | 2,330 | 4,730 | 1,820 | 635 | 635 | 358 | 500 |
| 11 | 1,820 | 3,070 | | | | 2,910 | 4,130 | 1,820 | 635 | 600 | 412 | 565 |
| 12 | 1,610 | 2,610 | | | | 11,600 | 3,940 | 2,330 | 750 | 500 | 440 | 470 |
| 13 | 1,410 | 2,330 | | | | 8,000 | 3,760 | 2,910 | 710 | 500 | 470 | 440 |
| 14 | 1,410 | 2,330 | | | | 5,370 | 3,230 | 2,610 | 440 | 635 | 470 | 385 |
| 15 | 1,310 | 2,330 | | | 850 | 4,520 | 2,910 | 2,190 | 1,610 | 532 | 440 | 440 |
| 16 | 1,410 | 2,190 | | 700 | | 4,730 | 3,760 | 1,820 | 1,130 | 600 | 385 | 470 |
| 17 | 1,410 | 2,060 | | | | 5,150 | 4,130 | 1,940 | 1,130 | 600 | 358 | 412 |
| 18 | 1,310 | 2,060 | | | | 5,370 | 3,940 | 2,330 | 910 | 600 | 440 | 440 |
| 19 | 1,220 | 2,060 | | | | 6,040 | 3,400 | 2,060 | 710 | 532 | 440 | 412 |
| 20 | 1,040 | 1,820 | 1,600 | | | 6,040 | 7,230 | 1,820 | 635 | 412 | 470 | 412 |
| 21 | 1,220 | 1,820 | | | | 6,270 | 6,500 | 1,610 | 600 | 635 | 672 | 268 |
| 22 | 1,130 | 1,820 | | | | 6,270 | 4,520 | 1,510 | 870 | 565 | 672 | 470 |
| 23 | 995 | 1,610 | | | | 5,590 | 3,760 | 1,410 | 950 | 500 | 532 | 470 |
| 24 | 995 | 1,610 | | | | 5,590 | 3,580 | 1,310 | 910 | 440 | 500 | 412 |
| 25 | 950 | 1,610 | | | | 11,300 | 3,230 | 1,410 | 870 | 470 | 635 | 385 |
| 26 | 950 | 1,610 | | | | 17,900 | 3,230 | 1,310 | 750 | 412 | 470 | 385 |
| 27 | 910 | 1,610 | | | | 12,200 | 3,400 | 1,220 | 790 | 358 | 710 | 440 |
| 28 | 995 | 1,410 | | | | 10,200 | 3,400 | 1,220 | 710 | 500 | 470 | 292 |
| 29 | 950 | 2,060 | | | | 9,900 | 3,070 | 1,130 | 870 | 440 | 440 | 440 |
| 30 | 1,130 | 2,470 | | | | 8,260 | 3,760 | 1,040 | 790 | 470 | 385 | 440 |
| 31 | 1,510 | ..... | | | | 7,480 | ..... | 995 | ..... | 470 | 321 | ..... |

NOTE.—Braced figures show mean discharge for periods indicated.

*Monthly discharge of Fox River at Wedron, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,500 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 830 | 176 | 423 | 0.169 | 0.19 |
| November | 1,040 | 385 | 639 | .256 | .29 |
| December | 1,610 | 440 | 1,030 | .412 | .48 |
| January | 2,060 | ..... | 1,230 | .492 | .57 |
| February | 1,820 | ..... | 1,150 | .460 | .48 |
| March | 14,900 | 1,220 | 5,700 | 2.28 | 2.63 |
| April | 3,760 | 1,820 | 2,740 | 1.10 | 1.23 |
| May | 11,900 | 1,040 | 3,860 | 1.54 | 1.78 |
| June | 1,220 | 565 | 960 | .384 | .43 |
| July | 1,040 | 268 | 506 | .202 | .23 |
| August | 440 | 255 | 357 | .143 | .16 |
| September | 710 | 216 | 345 | .138 | .15 |
| The year | 14,900 | 176 | 1,590 | .636 | 8.62 |
| 1919-20. | | | | | |
| October | 3,230 | 910 | 1,360 | .544 | .63 |
| November | 3,070 | 1,410 | 2,030 | .812 | .90 |
| December | ..... | ..... | 1,600 | .640 | .74 |
| January | ..... | ..... | 700 | .280 | .32 |
| February | ..... | ..... | 850 | .340 | .37 |
| March | 17,900 | 800 | 6,140 | 2.46 | 2.84 |
| April | 7,230 | 2,910 | 4,580 | 1.83 | 2.04 |
| May | 5,810 | 995 | 2,190 | .876 | 1.01 |
| June | 1,610 | 600 | 833 | .333 | .37 |
| July | 750 | 358 | 565 | .226 | .26 |
| August | 672 | 311 | 464 | .186 | .21 |
| September | 635 | 268 | 439 | .176 | .20 |
| The year | 17,900 | 268 | 1,820 | .728 | 9.89 |

### VERMILION RIVER NEAR STREATOR, ILL.

LOCATION.—In sec. 1, T. 30 N., R. 3 E. third principal meridian, at highway bridge, known as bridge No. 3, 1½ miles south of Streator, La Salle County, and 100 feet below Santa Fe Railway bridge.

DRAINAGE AREA.—1,080 square miles.

RECORDS AVAILABLE.—July 27, 1914, to September 30, 1920.

GAGE.—Chain gage attached to highway bridge; read by Floyd Leslie.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and rocks; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 12.95 feet at 4 p. m. March 17 (discharge, 6,830 second-feet); minimum discharge, 0.1 second-foot August 11, 12, 15, and 16.

Maximum stage recorded during year ending September 30, 1920, 22.9 feet at noon April 20 (discharge, 16,500 second-feet); minimum discharge, no flow, August 25–28 and September 16–30.

1914–1920: Maximum stage recorded, 22.9 feet April 20, 1920 (discharge, 16,500 second-feet); minimum discharge, no flow, August 25–28 and September 16–30, 1920.

ACCURACY.—Stage-discharge relation changed after high water of April and May, 1920; seriously affected by ice. Two rating curves used, both fairly well defined below 12,000 second-feet, applicable respectively, October 1, 1918, to May 31, 1920, and June 1 to September 30, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records good except for periods of extremely low water and periods of ice effect, for which they are poor.

No discharge measurements were made at this station during year ending September 30, 1920.

*Discharge measurements of Vermilion River near Streator, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. |
|---|---|---|
| | *Feet.* | *Sec.-ft.* |
| Aug. 4 | 0.93 | 17 |
| 4 | .93 | 16 |

*Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 21 | 684 | 252 | | 404 | 588 | 891 | 1,450 | 588 | 265 | 30 | 6.9 |
| 2 | 21 | 375 | 332 | | 375 | 1,010 | 818 | 1,600 | 464 | 240 | 19 | 4.4 |
| 3 | 18 | 375 | 216 | | 390 | 930 | 749 | 2,270 | 495 | 193 | 4.1 | 5.2 |
| 4 | 15 | 265 | 240 | | 404 | 818 | 716 | 3,340 | 684 | 156 | 9.4 | 3.8 |
| 5 | 12 | 182 | 182 | | 332 | 783 | 684 | 3,800 | 588 | 135 | 7.3 | 4.4 |
| | | | | 660 | | | | | | | | |
| 6 | 7.3 | 171 | 182 | | 240 | 783 | 652 | 3,560 | 434 | 85 | .2 | 6.0 |
| 7 | 1.0 | 160 | 216 | | 216 | 783 | 620 | 3,800 | 404 | 48 | .4 | 4.9 |
| 8 | 2.5 | 240 | 193 | | 360 | 783 | 588 | 3,130 | 434 | 24 | .3 | 5.2 |
| 9 | 3.8 | 390 | 204 | | 240 | 716 | 557 | 2,920 | 434 | 17 | .2 | 4.7 |
| 10 | 8.6 | 360 | 228 | | 193 | 716 | 557 | 2,780 | 404 | 684 | .2 | 4.9 |
| 11 | 5.2 | 419 | 204 | | 193 | 1,130 | 495 | 2,570 | 318 | 216 | .1 | 6.0 |
| 12 | 1.0 | 404 | 204 | | 265 | 783 | 495 | 2,570 | 193 | 146 | .1 | 8.1 |
| 13 | 5.2 | 375 | 252 | | 375 | 2,270 | 749 | 1,910 | 150 | 104 | .4 | 9.0 |
| 14 | 2.5 | 240 | 557 | | 390 | 2,390 | 684 | 1,750 | 140 | 100 | .4 | 5.2 |
| 15 | 7.3 | 252 | 749 | | 526 | 3,060 | 652 | 1,450 | 135 | 81 | .1 | 9.4 |
| | | | | 450 | | | | | | | | |
| 16 | 6.5 | 304 | 891 | | 684 | 3,800 | 684 | 1,010 | 434 | 20 | .1 | 12 |
| 17 | 9.0 | 390 | 854 | | 749 | 6,830 | 749 | 970 | 464 | 19 | 5.2 | 16 |
| 18 | 5.2 | 240 | 749 | | 818 | 6,020 | 749 | 854 | 684 | 16 | 1.0 | 15 |
| 19 | 12 | 167 | 716 | | 620 | 5,480 | 684 | 749 | 716 | 28 | 3.8 | 16 |
| 20 | 1.0 | 404 | 652 | | 620 | 5,080 | 620 | 716 | 434 | 45 | 4.9 | 16 |
| 21 | 2.5 | 193 | 652 | 500 | 620 | 3,560 | 588 | 684 | 434 | 16 | 2.5 | 21 |
| 22 | 6.5 | 182 | 1,500 | 557 | 557 | 2,850 | 557 | 620 | 375 | 13 | 2.4 | 16 |
| 23 | 21 | 154 | 1,700 | 621 | 557 | 2,270 | 749 | 652 | 375 | 10 | 1.6 | 14 |
| 24 | 25 | 154 | 1,750 | 685 | 557 | 2,030 | 716 | 588 | 390 | 4.4 | 4.7 | 5.2 |
| 25 | 30 | 65 | 1,450 | 749 | 557 | 1,700 | 620 | 495 | 588 | 4.1 | 5.2 | 6.0 |
| 26 | 160 | 144 | 1,250 | 749 | 588 | 1,500 | 620 | 404 | 1,130 | .8 | 6.0 | 6 9 |
| 27 | 1,130 | 46 | 1,300 | 716 | 620 | 1,400 | 464 | 390 | 1,350 | .7 | 4.9 | 7.3 |
| 28 | 818 | 390 | 1,350 | 557 | 526 | 1,210 | 930 | 652 | 749 | .3 | 2.5 | 15 |
| 29 | 749 | 375 | 1,210 | 526 | ..... | 1,170 | 1,010 | 620 | 464 | .4 | 4.9 | 26 |
| 30 | 684 | 154 | 930 | 464 | ..... | 1,050 | 1,090 | 588 | 375 | .4 | 5.2 | 39 |
| 31 | 434 | ..... | 930 | 464 | ..... | 970 | ..... | 464 | ..... | 45 | 6.0 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 30 | 21 | 39 | | | | 1,250 | 2,270 | 460 | 9 | 22 | 0.2 |
| 2 | 49 | 10 | 61 | | | | 783 | 2,270 | 660 | 9 | 19 | .1 |
| 3 | 26 | 6.0 | 49 | | | | 1,210 | 2,270 | 730 | 21 | 18 | .1 |
| 4 | 30 | 12 | 30 | | | | 854 | 2,270 | 730 | 9 | 11 | .1 |
| 5 | 15 | 12 | 39 | | | 15 | 749 | 1,750 | 730 | 11 | 8.5 | .5 |
| 6 | 9.4 | 13 | 49 | | | | 557 | 1,450 | 730 | 20 | 7.0 | .4 |
| 7 | 5.2 | 15 | 30 | | | | 434 | 818 | 730 | 14 | 1.9 | .4 |
| 8 | 6.0 | 18 | | | | | 434 | 783 | 625 | 11 | 2.6 | .2 |
| 9 | 5.2 | 5.2 | | | | | 169 | 749 | 248 | 12 | 1.8 | .2 |
| 10 | 9.0 | 9.4 | | | | 404 | 182 | 749 | 235 | 14 | 1.6 | .2 |
| 11 | 10.6 | 18 | | | | 854 | 240 | 1,090 | 235 | 22 | .9 | .2 |
| 12 | 15 | 18 | | | | 7,820 | 240 | 1,700 | 222 | 22 | .8 | .2 |
| 13 | 6.5 | 20 | | | | 3,480 | 252 | 1,300 | 185 | 14 | .5 | .2 |
| 14 | 10.6 | 21 | | | | 3,340 | 252 | 1,210 | 136 | 18 | .2 | .1 |
| 15 | 10.0 | 18 | | | 45 | 2,780 | 265 | 1,130 | 134 | 14 | .2 | .1 |
| | | | | 30 | | | | | | | | |
| 16 | 9.4 | 24 | | | | 2,270 | 495 | 1,130 | 35 | 12 | .2 | 0 |
| 17 | 6.0 | 26 | | | | 1,130 | 1,550 | 1,090 | 25 | 8 | .1 | 0 |
| 18 | 5.2 | 30 | | | | 1,090 | 6,650 | 1,650 | 45 | 1.8 | .1 | 0 |
| 19 | 9.0 | 25 | | | | 1,050 | 8,020 | 1,650 | 55 | 1.6 | .1 | 0 |
| 20 | 9.4 | 32 | 25 | | | 818 | 16,500 | 1,600 | 95 | 2.3 | .1 | 0 |
| 21 | 5.2 | 23 | | | | 818 | 5,080 | 1,400 | 92 | 1.6 | .1 | 0 |
| 22 | 8.6 | 24 | | | | 783 | 5,160 | 1,600 | 66 | 1.8 | .1 | 0 |
| 23 | 9.0 | 49 | | | | 818 | 4,520 | 1,550 | 55 | 1.7 | .1 | 0 |
| 24 | 9.4 | 39 | | | | 1,090 | 4,040 | 1,210 | 65 | 1.5 | .1 | 0 |
| 25 | 10.6 | 30 | | | | 1,550 | 3,720 | 891 | 58 | 14 | 0 | 0 |
| 26 | 9.4 | 34 | | | | 1,550 | 2,920 | 749 | 55 | 20 | 0 | 0 |
| 27 | 12 | 1.0 | | | | 1,550 | 2,330 | 652 | 23 | 19 | 0 | 0 |
| 28 | 6.0 | 2.5 | | | | 1,500 | 2,270 | 495 | 19 | 11 | 0 | 0 |
| 29 | 9.0 | 39 | | | | 1,550 | 2,210 | 495 | 9 | 12 | .5 | 0 |
| 30 | 24 | 30 | | | ..... | 1,550 | 1,700 | 464 | 10 | 14 | .4 | 0 |
| 31 | 21 | ..... | | | ..... | 1,550 | ..... | 464 | ..... | 22 | .3 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 1–20, 1919, and Dec. 8, 1919, to Mar. 9, 1920; mean discharge ascertained by means of gage heights, observer's notes, and weather records. Discharge interpolated on account of lack of gage readings, Jan. 21, 23, and 24, 1919. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Vermilion River near Streator, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,080 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,130 | 1.0 | 136 | 0.126 | 0.15 |
| November | 684 | 46 | 275 | .255 | .28 |
| December | 1,750 | 182 | 713 | .660 | .76 |
| January | ..... | ..... | 571 | .529 | .61 |
| February | 818 | 193 | 463 | .429 | .45 |
| March | 6,830 | 588 | 2,080 | 1.93 | 2.22 |
| April | 1,090 | 464 | 691 | .640 | .71 |
| May | 3,800 | 390 | 1,590 | 1.47 | 1.70 |
| June | 1,350 | 135 | 494 | .457 | .51 |
| July | 684 | .3 | 87.6 | .081 | .09 |
| August | 30 | .1 | 4.29 | .004 | .005 |
| September | 39 | 3.8 | 10.6 | .010 | .01 |
| The year | 6,830 | .1 | 597 | .553 | 7.49 |
| 1919–20. | | | | | |
| October | 49 | 5.2 | 12.9 | .012 | .01 |
| November | 49 | 1.0 | 20.8 | .019 | .02 |
| December | ..... | ..... | 29.0 | .027 | .03 |
| January | ..... | ..... | 30.0 | .028 | .03 |
| February | ..... | ..... | 45.0 | .042 | .05 |
| March | 7,820 | ..... | 1,270 | 1.18 | 1.36 |
| April | 16,500 | 169 | 2,500 | 2.31 | 2.58 |
| May | 2,270 | 464 | 1,250 | 1.16 | 1.34 |
| June | 730 | 9 | 250 | .231 | .26 |
| July | 22 | 1.4 | 11.7 | .011 | .01 |
| August | 22 | .0 | 3.17 | .003 | .003 |
| September | .5 | .0 | .11 | .000 | .000 |
| The year | 16,500 | 0.0 | 452 | .419 | 5.69 |

## SPOON RIVER AT SEVILLE, ILL.

LOCATION.—In sec. 24, T. 6 N., R. 1 E. fourth principal meridian, at Toledo, Peoria & Western Railway bridge, a quarter of a mile east of railway station at Seville, Fulton County.

DRAINAGE AREA.—1,600 square miles.

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by R. M. Boales.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading. Measurements made during rapidly changing stages are corrected for change in stage by method described in Water-Supply Paper 375.

CHANNEL AND CONTROL.—A loose rock dam, about 2 miles downstream from gage, used to create a reservoir for the pumping station of the Toledo, Peoria & Western Railway, forms control for medium stages; at other stages control is composed of sand and clay and is somewhat shifting. Dam was removed August, 1918, and replaced August, 1919.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 17.4 feet June 4 (discharge, 9,600 second-feet); minimum discharge, 42 second-feet September 13 (determined by current-meter measurement).

Maximum stage recorded during year ending September 30, 1920, 19.4 feet March 12 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 18.7 feet April 22 (discharge, 11,000 second-feet); minimum stage, 2.36 feet September 6 and 10 (discharge, 27 second-feet).

1914–1920: Maximum stage recorded, 26.0 feet January 23, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 23.0 feet January 24, 1916 (discharge, 17,800 second-feet); minimum stage, 1.35 feet July 31 and August 27–29, 1914 (discharge, 3.8 second-feet).

ACCURACY.—Stage-discharge relation changed slightly by high water of January, 1916, September, 1917, and May, 1920, and also by removal and rebuilding of dam 2 miles downstream during period noted above (see under "Channel and control"); seriously affected by ice. Four rating curves used, all fairly well defined below 10,000 second-feet, applicable, respectively, July 24, 1914, to January 20, 1916, and September 11, 1917, to August 25, 1918, and August 16, 1919, to May 31, 1920; January 21, 1916, to September 10, 1917; August 26, 1918, to August 15, 1919; June 1 to September 30, 1920. Gage read to quarter-tenths once daily prior to September 30, 1915, and thereafter to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair; winter records poor.

No discharge measurements were made at this station during the year ending September 30, 1920.

*Discharge measurements of Spoon River at Seville, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Apr. 1 | 5.90 | 1,220 | Aug. 6 | 3.74 | 318 | Aug. 8 | 5.07 | 872 |
| June 6 | 13.28 | [a] 5,380 | 6 | 4.04 | 473 | Sept. 13 | 2.47 | 42 |
| 6 | 11.81 | [b] 4,460 | 8 | 5.37 | 1,010 | 13 | 2.47 | 43 |

[a] Discharge corrected for falling stage=5,920 sec.-ft.
[b] Discharge corrected for falling stage=4,860 sec.-ft.

*Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920.*

| Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1914. | | | | 1914. | | | | 1914. | | | |
| 1 | | 4.5 | 4.5 | 11 | | 4.2 | 170 | 21 | | 6.1 | 180 |
| 2 | | 4.5 | 17 | 12 | | 4.2 | 130 | 22 | | 4.5 | 140 |
| 3 | | 6.5 | 38 | 13 | | 4.5 | 114 | 23 | | 4.5 | 120 |
| 4 | | 5.5 | 46 | 14 | | 4.5 | 92 | 24 | 5.5 | 4.5 | 89 |
| 5 | | 5.5 | 101 | 15 | | 34 | 3,100 | 25 | 5.5 | 4.5 | 71 |
| 6 | | 5.5 | 540 | 16 | | 14 | 6,130 | 26 | 4.9 | 4.5 | 60 |
| 7 | | 4.5 | 3,540 | 17 | | 14 | 3,540 | 27 | 6.5 | 3.8 | 56 |
| 8 | | 4.5 | 700 | 18 | | 8.5 | 790 | 28 | 6.5 | 3.8 | 48 |
| 9 | | 4.5 | 435 | 19 | | 6.9 | 365 | 29 | 4.9 | 3.8 | 44 |
| 10 | | 4.5 | 940 | 20 | | 6.5 | 215 | 30 | 4.9 | 4.5 | 38 |
| | | | | | | | | 31 | 3.8 | 4.5 | |

*Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1914–15. | | | | | | | | | | | | |
| 1 | 37 | 30 | 34 | | | 470 | 130 | 63 | 5,510 | 270 | 5,370 | 130 |
| 2 | 32 | 28 | 34 | | | 400 | 130 | 63 | 1,140 | 1,720 | 5,370 | 130 |
| 3 | 31 | 28 | 37 | 27 | | 365 | 130 | 82 | 1,090 | 655 | 8,200 | 130 |
| 4 | 26 | 28 | 37 | | | 330 | 130 | 75 | 840 | 300 | 6,450 | 130 |
| 5 | 25 | 26 | 37 | | | 365 | 130 | 80 | 655 | 255 | 4,950 | 150 |
| | | | | | 3,600 | | | | | | | |
| 6 | 25 | 26 | 37 | 40 | | 300 | 130 | 99 | 575 | 215 | 3,610 | 130 |
| 7 | 25 | 26 | 37 | 52 | | 300 | 130 | 62 | 540 | 270 | 3,170 | 130 |
| 8 | 24 | 25 | 38 | 65 | | 300 | 140 | 170 | 435 | 1,190 | 2,290 | 130 |
| 9 | 31 | 24 | 38 | 92 | | 300 | 140 | 70 | 160 | 990 | 1,830 | 240 |
| 10 | 105 | 24 | 38 | 92 | | 300 | 150 | 73 | 365 | 1,240 | 1,560 | 150 |
| 11 | 101 | 22 | 37 | 110 | 2,980 | 300 | 150 | 73 | 365 | 3,290 | 1,720 | 3,610 |
| 12 | 330 | 22 | 31 | 110 | 2,980 | 285 | 150 | 63 | 330 | 2,660 | 890 | ..... |
| 13 | 170 | 22 | 34 | 106 | 3,170 | 270 | 140 | 88 | 300 | 990 | 745 | ..... |
| 14 | 114 | 22 | 21 | 89 | 3,230 | 270 | 140 | 73 | 270 | 505 | 575 | ..... |
| 15 | 114 | 22 | | 89 | 1,940 | 255 | 130 | 60 | 285 | 2,410 | 470 | ..... |
| 16 | 96 | 22 | | 96 | 1,140 | 240 | 130 | 48 | 365 | 4,170 | 1,620 | ..... |
| 17 | 150 | 22 | | | 840 | 240 | 130 | 67 | 300 | 1,140 | 1,090 | ..... |
| 18 | 106 | 22 | | | 700 | 240 | 110 | 60 | 348 | 940 | 655 | ..... |
| 19 | 110 | 21 | | | 615 | 240 | 110 | 96 | 365 | 1,140 | 505 | ..... |
| 20 | 101 | 22 | | | 575 | 240 | 110 | 44 | 160 | 990 | 365 | ..... |
| 21 | 92 | 24 | | | 540 | 215 | 106 | 215 | 365 | 990 | 470 | ..... |
| 22 | 71 | 24 | | | 540 | 190 | 116 | 228 | 315 | 790 | 400 | ..... |
| 23 | 65 | 24 | 20 | | 940 | 190 | 126 | 80 | 255 | 470 | 365 | ..... |
| 24 | 60 | 24 | | 700 | 1,620 | 190 | 140 | 122 | 240 | 540 | 300 | ..... |
| 25 | 50 | 24 | | | 1,090 | 190 | 140 | 285 | 190 | 470 | 300 | ..... |
| 26 | 44 | 28 | | | 890 | 190 | 126 | 1,040 | 3,170 | 365 | 240 | ..... |
| 27 | 38 | 28 | | | 435 | 180 | 69 | 1,290 | 228 | 330 | 240 | ..... |
| 28 | 38 | 28 | | | 540 | 170 | 82 | 940 | 300 | 215 | 202 | 700 |
| 29 | 32 | 28 | | | ..... | 160 | 75 | 2,790 | 240 | 1,090 | 190 | 700 |
| 30 | 31 | 31 | | | ..... | 150 | 75 | 5,650 | 215 | 3,670 | 130 | 505 |
| 31 | 30 | ..... | | | ..... | 130 | ..... | 4,950 | ..... | 5,510 | 130 | ..... |
| 1915–16. | | | | | | | | | | | | |
| 1 | 505 | 170 | 745 | 4,420 | 2,980 | 730 | 2,500 | 595 | 1,640 | 1,070 | 82 | 45 |
| 2 | 400 | 150 | 745 | 4,420 | 1,870 | 555 | 3,100 | 685 | 1,480 | 1,020 | 97 | 45 |
| 3 | 435 | 130 | 745 | 4,950 | 1,370 | 555 | 2,800 | 730 | 3,580 | 1,020 | 180 | 49 |
| 4 | 365 | 130 | 655 | 4,950 | | 445 | 2,320 | 685 | 3,580 | 920 | 155 | 45 |
| 5 | 330 | 110 | 575 | 4,300 | | 445 | 1,980 | 685 | 2,080 | 870 | 115 | 53 |
| 6 | 330 | 130 | 505 | 3,670 | | 555 | 1,640 | 595 | 1,420 | 555 | 115 | 515 |
| 7 | 300 | 130 | 505 | 3,040 | | 820 | 1,480 | 555 | 1,870 | 315 | 97 | 375 |
| 8 | 300 | 130 | 540 | 1,830 | 2,250 | 555 | 1,370 | 515 | 2,500 | 230 | 180 | 285 |
| 9 | 190 | 130 | 575 | 990 | | 640 | 1,270 | 480 | 2,200 | 315 | 97 | 180 |
| 10 | 1,620 | 130 | 505 | 1,090 | | 515 | 1,120 | 445 | 2,200 | 315 | 82 | 115 |
| 11 | 790 | 130 | 505 | 745 | | 555 | 1,020 | 410 | 1,980 | 285 | 230 | 82 |
| 12 | 700 | 110 | 540 | | | 480 | 970 | 375 | 1,640 | 285 | 515 | 76 |
| 13 | 215 | 110 | 540 | | 1,870 | 445 | 920 | 820 | 1,370 | 255 | 1,120 | 515 |
| 14 | 240 | 92 | 470 | | 1,590 | 480 | 970 | 3,460 | 1,220 | 255 | 555 | 820 |
| 15 | 270 | 92 | 470 | | 1,540 | 445 | 870 | 3,160 | 1,070 | 255 | 345 | 685 |
| 16 | 240 | 77 | 470 | 1,800 | 1,420 | 410 | 820 | 2,860 | 1,070 | 230 | 180 | 285 |
| 17 | 215 | 76 | 470 | | 2,800 | 375 | 870 | 1,920 | 1,420 | 205 | 155 | 285 |
| 18 | 130 | 76 | 540 | | 4,150 | 410 | 870 | 1,480 | 1,120 | 205 | 315 | 125 |
| 19 | 300 | 92 | 505 | | 410 | 775 | 1,220 | 870 | 180 | 205 | 82 | |
| 20 | 270 | 130 | 470 | | 2,200 | 375 | 820 | 1,070 | 775 | 180 | 135 | 285 |
| 21 | 270 | 130 | 470 | | 1,640 | 375 | 970 | 1,170 | 4,300 | 155 | 115 | 82 |
| 22 | 215 | 130 | 190 | 17,500 | 1,540 | 445 | 970 | 1,070 | 4,880 | 155 | 97 | 70 |
| 23 | 130 | 150 | 215 | | 1,870 | 445 | 870 | 1,220 | 2,380 | 155 | 90 | 61 |
| 24 | 110 | 170 | 400 | 17,800 | 2,500 | 480 | 775 | 1,760 | 1,640 | 115 | 145 | 70 |
| 25 | 110 | 190 | 400 | 13,200 | | 480 | 685 | 3,580 | 1,020 | 115 | 97 | 61 |
| 26 | 92 | 400 | 400 | 2,200 | 1,170 | 685 | 685 | 2,560 | 1,220 | 70 | 76 | 61 |
| 27 | 110 | 1,190 | 400 | 5,510 | 870 | 2,380 | 685 | 3,400 | 1,070 | 61 | 76 | 70 |
| 28 | 65 | 1,670 | 330 | 7,300 | 730 | 5,810 | 640 | 4,820 | 870 | 61 | 70 | 135 |
| 29 | 92 | 1,290 | 330 | 9,200 | 595 | 5,650 | 595 | 2,800 | 775 | 30 | 61 | 180 |
| 30 | 190 | 790 | 300 | 7,560 | ..... | 4,120 | 555 | 2,320 | 685 | 115 | 53 | 125 |
| 31 | 170 | ..... | 300 | 4,620 | ..... | 3,160 | ..... | 2,080 | ..... | 82 | 45 | ..... |

*Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1916–17. | | | | | | | | | | | | |
| 1 | 115 | 180 | 230 | | | | 445 | 4,120 | 1,120 | 1,810 | 410 | 125 |
| 2 | 70 | 135 | 205 | | | | 445 | 3,220 | 1,120 | 1,640 | 330 | 76 |
| 3 | 65 | 155 | 205 | 300 | 440 | | 375 | 1,980 | 820 | 1,480 | 300 | 65 |
| 4 | 61 | 155 | 205 | | | | 330 | 1,920 | 685 | 920 | 230 | 375 |
| 5 | 49 | 155 | 205 | | | 85 | 445 | 1,920 | 10,400 | 920 | 230 | 410 |
| 6 | 45 | 155 | 180 | | | | 515 | 1,020 | 7,390 | 870 | 218 | 525 |
| 7 | 45 | 135 | 180 | | | | 515 | 775 | 6,620 | 515 | 205 | 640 |
| 8 | 45 | 135 | 180 | 1,550 | 185 | | 515 | 685 | 5,020 | 445 | 180 | 730 |
| 9 | 45 | 515 | 180 | | | | 445 | 515 | 3,100 | 375 | 180 | 1,270 |
| 10 | 45 | 595 | 255 | | | 185 | 515 | 820 | 2,920 | 970 | 125 | 2,860 |
| 11 | 37 | 480 | 180 | | | | 555 | 870 | 2,800 | 775 | 106 | 3,170 |
| 12 | 41 | 410 | 115 | | | 640 | 515 | 820 | 2,560 | 595 | 90 | 2,050 |
| 13 | 49 | 315 | | 450 | | 3,760 | 315 | 775 | 7,660 | 555 | 82 | 1,830 |
| 14 | 61 | 255 | | | 280 | 7,340 | 360 | 640 | 9,400 | 445 | 315 | 1,720 |
| 15 | 70 | 230 | | | | 8,600 | 375 | 640 | 13,400 | 410 | 300 | 1,140 |
| 16 | 82 | 180 | | | | 9,700 | 315 | 555 | 10,700 | 360 | 230 | 615 |
| 17 | 76 | 180 | | | | 4,690 | 330 | 515 | 7,390 | 1,070 | 180 | 170 |
| 18 | 70 | 205 | | | | 2,080 | 730 | 480 | 5,090 | 920 | 155 | 540 |
| 19 | 70 | 205 | | 240 | | 1,920 | 870 | 445 | 3,820 | 445 | 135 | 540 |
| 20 | 70 | 205 | 55 | | | 1,700 | 2,860 | 410 | 2,560 | 168 | 97 | 575 |
| 21 | 375 | 180 | | | | 1,700 | 2,320 | 360 | 1,590 | 65 | 65 | 575 |
| 22 | 555 | 205 | | | 80 | 1,640 | 1,370 | 445 | 1,480 | 205 | 970 | 540 |
| 23 | 285 | 255 | | | | 2,860 | 1,170 | 515 | 1,420 | 180 | 515 | 505 |
| 24 | 315 | 345 | | | | 2,860 | 1,420 | 445 | 1,420 | 515 | 445 | 470 |
| 25 | 345 | 315 | | 1,800 | | 1,540 | 1,640 | 410 | 1,270 | 1,480 | 410 | 435 |
| 26 | 375 | 255 | | | | 730 | 1,540 | 410 | 1,270 | 920 | 345 | 382 |
| 27 | 445 | 255 | | | | 595 | 1,590 | 445 | 1,170 | 640 | 285 | 382 |
| 28 | 410 | 255 | | | | 515 | 1,700 | 345 | 1,640 | 445 | 180 | 365 |
| 29 | 315 | 255 | 1,000 | 600 | ..... | 515 | 1,700 | 330 | 2,680 | 410 | 315 | 348 |
| 30 | 255 | 230 | | | ..... | 480 | 2,030 | 300 | 1,270 | 375 | 285 | 330 |
| 31 | 230 | ..... | | | ..... | 445 | ..... | 1,070 | ..... | 445 | 218 | ..... |
| 1917–18. | | | | | | | | | | | | |
| 1 | 150 | 1,140 | 120 | | ..... | 1,720 | 285 | 1,240 | 1,290 | 1,500 | 540 | 2,110 |
| 2 | 130 | 1,140 | 120 | | ..... | 1,720 | 285 | 1,190 | 1,140 | ..... | 348 | 1,140 |
| 3 | 116 | 1,090 | 118 | | ..... | 2,310 | 1,620 | 1,190 | 1,040 | ..... | 300 | 585 |
| 4 | 105 | 990 | 120 | | ..... | 2,910 | 285 | 1,190 | 1,040 | ..... | 240 | 955 |
| 5 | 215 | 990 | 110 | | ..... | 1,670 | 285 | 435 | 1,040 | ..... | 228 | 820 |
| 6 | 190 | 940 | 101 | 60 | ..... | 1,670 | 285 | 435 | 1,780 | ..... | 215 | 740 |
| 7 | 190 | 940 | | | ..... | 1,040 | 700 | 330 | 1,670 | ..... | 180 | 620 |
| 8 | 540 | 840 | | | 190 | 990 | 790 | 330 | 1,240 | ..... | 170 | 515 |
| 9 | 435 | 505 | | | 1,190 | 990 | 890 | 330 | 1,240 | ..... | 160 | 445 |
| 10 | 270 | 400 | | | 1,590 | 990 | 700 | 348 | 770 | 7,040 | 170 | 410 |
| 11 | 202 | 348 | | | 1,990 | 505 | 700 | 348 | 300 | 4,050 | 270 | 375 |
| 12 | 150 | 315 | 60 | | 5,970 | 505 | 700 | 330 | 418 | 2,230 | 215 | 445 |
| 13 | 77 | 300 | | | 6,450 | 470 | 615 | 330 | 470 | 1,500 | 190 | 585 |
| 14 | 92 | 285 | | | 6,700 | 470 | 840 | 315 | 365 | 1,190 | 140 | 515 |
| 15 | 83 | 270 | | | 6,960 | 470 | 1,090 | 315 | 215 | 990 | 418 | 445 |
| 16 | 1,940 | 240 | | | 7,560 | 470 | 1,340 | 505 | 140 | 890 | 1,720 | 375 |
| 17 | 2,660 | 228 | | | 1,040 | 505 | 1,340 | 505 | 180 | 990 | 1,090 | 345 |
| 18 | 1,940 | 202 | | 30 | 1,040 | 505 | 1,340 | 575 | 180 | 700 | 1,500 | 315 |
| 19 | 1,940 | 190 | 75 | | 990 | 505 | 1,340 | 655 | 180 | 615 | 3,480 | 285 |
| 20 | 1,940 | 180 | 100 | | 940 | 470 | 1,340 | 700 | 170 | 540 | 2,410 | 285 |
| 21 | 1,830 | 170 | 125 | | 940 | 470 | 1,290 | 990 | 130 | 470 | 840 | 270 |
| 22 | 1,780 | 160 | 150 | | 840 | 470 | 1,240 | 1,720 | 130 | 435 | 540 | 255 |
| 23 | 1,780 | 150 | 265 | | 840 | 470 | 1,240 | 1,940 | 130 | 382 | 418 | 230 |
| 24 | 1,670 | 110 | 380 | | 840 | 300 | 1,240 | 2,470 | 180 | 365 | 348 | 230 |
| 25 | 1,560 | 96 | 505 | | 700 | 270 | 1,190 | 3,920 | 1,140 | 315 | 300 | 230 |
| 26 | 1,560 | 96 | 450 | ..... | 700 | 285 | 1,190 | 3,540 | 1,720 | 348 | 270 | 230 |
| 27 | 1,500 | 97 | 400 | ..... | 655 | 285 | 1,190 | 3,100 | 3,730 | 348 | 270 | 205 |
| 28 | 1,500 | 97 | 350 | ..... | 1,720 | 285 | 1,290 | 2,470 | 5,230 | 315 | 218 | 192 |
| 29 | 1,440 | 97 | | ..... | ..... | 285 | 890 | 2,540 | 5,440 | 330 | 205 | 180 |
| 30 | 1,290 | 110 | 170 | ..... | ..... | 285 | 1,240 | 2,170 | 4,500 | 1,620 | 255 | 180 |
| 31 | 1,240 | ..... | | ..... | ..... | 285 | ..... | 1,720 | ..... | 1,390 | 1,390 | ..... |

*Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 192 | 550 | 660 | 2,050 | 820 | 1,440 | 1,290 | 785 | 820 | 550 | 1,440 | 60 |
| 2 | 180 | 585 | 660 | | 740 | 1,190 | 1,290 | 785 | 865 | 490 | 2,230 | 55 |
| 3 | 168 | 515 | 515 | | 740 | 1,340 | 1,140 | 785 | 3,980 | 515 | 445 | 71 |
| 4 | 180 | 480 | 550 | | 740 | 1,340 | 1,140 | 4,300 | 9,600 | 445 | 345 | 75 |
| 5 | 192 | 515 | 515 | | 620 | 1,140 | 1,090 | 5,650 | 8,110 | 410 | 445 | 65 |
| | | | | 1,070 | | | | | | | | 64 |
| 6 | 180 | 410 | 480 | | 620 | 820 | 1,040 | 5,810 | 7,300 | 515 | 410 | 59 |
| 7 | 180 | 875 | 445 | | 700 | 820 | 1,000 | 5,970 | 3,290 | 375 | 515 | 61 |
| 8 | 155 | 410 | 445 | | 660 | 1,000 | 910 | 5,810 | 2,720 | 360 | 1,290 | 59 |
| 9 | 155 | 360 | 445 | | 515 | 1,090 | 955 | 4,950 | 2,170 | 315 | 620 | 59 |
| 10 | 155 | 515 | 1,340 | | 585 | 1,090 | 955 | 3,920 | 1,830 | 1,040 | 330 | 57 |
| 11 | 155 | 480 | 445 | | 910 | 1,190 | 910 | 3,040 | 1,620 | 955 | 255 | 57 |
| 12 | 155 | 410 | 445 | | 740 | 1,290 | 820 | 2,540 | 1,390 | 865 | 218 | 59 |
| 13 | 145 | 410 | 445 | | 740 | 1,390 | 785 | 2,350 | 1,290 | 410 | 205 | 54 |
| 14 | 155 | 410 | 480 | 320 | 1,140 | 1,340 | 740 | 1,940 | 1,140 | 375 | 315 | 50 |
| 15 | 145 | 360 | 585 | | 1,290 | 1,340 | 865 | 1,720 | 1,140 | 360 | 255 | 48 |
| 16 | 135 | 515 | 660 | | 1,140 | 4,880 | 910 | 1,620 | 1,040 | 1,390 | 270 | 46 |
| 17 | 135 | 550 | 700 | | 955 | 6,790 | 1,000 | 1,500 | 910 | 910 | 190 | 45 |
| 18 | 145 | 785 | 700 | | 910 | 7,840 | 865 | 1,340 | 865 | 820 | 180 | 65 |
| 19 | 135 | 1,670 | 550 | | 865 | 7,300 | 820 | 1,240 | 865 | 785 | 140 | 140 |
| 20 | 135 | 1,500 | 550 | | 785 | 5,840 | 785 | 1,190 | 865 | 330 | 150 | 92 |
| 21 | 135 | 375 | 620 | 1,750 | 820 | 4,050 | 740 | 1,140 | 1,040 | 300 | 140 | 365 |
| 22 | 135 | 315 | 700 | | 785 | 3,170 | 700 | 1,090 | 955 | 270 | 202 | 470 |
| 23 | 135 | 360 | 865 | | 820 | 2,720 | 700 | 1,140 | 820 | 255 | 160 | 270 |
| 24 | 192 | 315 | 910 | 2,700 | 820 | 2,410 | 1,880 | 1,340 | 740 | 218 | 170 | 160 |
| 25 | 315 | 270 | 785 | | 955 | 2,230 | 1,390 | 1,940 | 2,410 | 218 | 150 | 110 |
| 26 | 480 | 255 | 660 | 3,360 | 1,090 | 2,110 | 865 | 1,620 | 1,190 | 218 | 120 | 77 |
| 27 | 660 | 218 | 320 | 2,720 | 1,090 | 1,880 | 785 | 1,290 | 910 | 218 | 110 | 77 |
| 28 | 785 | 375 | 2,230 | 1,240 | 1,340 | 1,720 | 785 | 1,190 | 660 | 192 | 92 | 71 |
| 29 | 1,560 | 785 | 2,230 | 1,000 | ..... | 1,620 | 740 | 1,090 | 620 | 180 | 84 | 170 |
| 30 | 1,340 | 820 | 2,110 | 955 | ..... | 1,500 | 785 | 955 | 585 | 1,140 | 77 | 382 |
| 31 | 740 | ..... | 2,540 | 865 | ..... | 1,440 | ..... | 910 | ..... | 445 | 65 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 190 | 365 | 1,040 | | | | 1,340 | 2,790 | 2,700 | 240 | 63 | 32 |
| 2 | 348 | 215 | 575 | | | | 1,390 | 2,720 | 1,660 | 255 | 70 | 30 |
| 3 | 270 | 215 | | | | | 1,240 | 2,290 | 1,990 | 365 | 70 | 28 |
| 4 | 255 | 202 | | | | | 1,090 | 1,940 | 1,990 | 210 | 58 | 29 |
| 5 | 180 | 190 | | | | | 940 | 1,720 | 1,180 | 138 | 52 | 28 |
| 6 | 150 | 180 | 520 | | | | 890 | 1,500 | 980 | 470 | 52 | 27 |
| 7 | 418 | 190 | | | | | 1,140 | 1,390 | 830 | 1,820 | 51 | 28 |
| 8 | 300 | 130 | | | 900 | 2,400 | 1,560 | 1,290 | 780 | 700 | 51 | 28 |
| 9 | 240 | 140 | | | | | 2,350 | 1,190 | 740 | 418 | 50 | 28 |
| 10 | 215 | 615 | | | | | 2,230 | 1,090 | 660 | 285 | 52 | 27 |
| 11 | 120 | 1,090 | | | | | 1,670 | 890 | 620 | 382 | 300 | 28 |
| 12 | 101 | 1,090 | | | | | 1,340 | 3,480 | 540 | 240 | 150 | 29 |
| 13 | 240 | 340 | | | | | 1,190 | 4,620 | 595 | 185 | 240 | 29 |
| 14 | 265 | 365 | | | | | 1,240 | 4,760 | 470 | 210 | 120 | 28 |
| 15 | 215 | 315 | | | | 5,090 | 1,040 | 3,920 | 435 | 210 | 80 | 40 |
| 16 | 190 | 270 | | 115 | | 1,880 | 1,880 | 2,600 | 400 | 185 | 84 | 50 |
| 17 | 150 | 240 | | | | 1,490 | 4,560 | 2,850 | 365 | 172 | 70 | 48 |
| 18 | 120 | 228 | | | | 940 | 3,230 | 3,040 | 365 | 140 | 60 | 45 |
| 19 | 110 | 215 | | | | 890 | 6,130 | 2,720 | 348 | 140 | 50 | 40 |
| 20 | 170 | 215 | | | | 990 | 7,390 | 2,410 | 330 | 150 | 48 | 38 |
| 21 | 126 | 202 | 210 | | | 840 | 9,600 | 2,050 | 300 | 140 | 46 | 35 |
| 22 | 101 | 170 | | | | 700 | 11,000 | 1,780 | 315 | 172 | 40 | 32 |
| 23 | 77 | 160 | | | 250 | 540 | 9,600 | 3,540 | 348 | 108 | 38 | 30 |
| 24 | 71 | 170 | | | | 665 | 3,800 | 5,390 | 418 | 104 | 33 | 29 |
| 25 | 65 | 180 | | | | 665 | 2,980 | 3,890 | 315 | 98 | 40 | 28 |
| 26 | 106 | 170 | | | | 3,800 | 2,600 | 2,290 | 270 | 94 | 42 | 32 |
| 27 | 110 | 170 | | | | 5,020 | 2,600 | 2,050 | 240 | 87 | 38 | 40 |
| 28 | 120 | 170 | | | | 4,420 | 2,720 | 1,780 | 225 | 63 | 38 | 33 |
| 29 | 150 | 540 | | | | 3,800 | 2,660 | 1,440 | 188 | 69 | 37 | 32 |
| 30 | 215 | 1,340 | | | ..... | 1,940 | 3,040 | 1,240 | 285 | 73 | 36 | 33 |
| 31 | 315 | ..... | | | ..... | 1,620 | ..... | 1,140 | ..... | 76 | 32 | ..... |

NOTE.—Stage-discharge relation affected by ice, Dec. 15, 1914, to Jan. 5, 1915, Jan. 17 to Feb. 10, 1915, Jan. 12–23, Feb. 4–12, 18, 19, 24, 25, 1916, Dec. 11, 1916, to Mar. 12, 1917, Dec. 7–18, 1917, Dec. 29, 1917, to about Feb. 5, 1918, Jan. 1–25, 1919, and Dec. 3, 1919, to Mar. 14, 1920; mean discharge ascertained by means of gage heights, observer's notes, and weather records. Gage not read, discharge not determined, Sept. 12–27, 1915, Jan. 26 to Feb. 7, 1918, and July 2–9, 1918. Gage not read, discharge interpolated, Jan. 7, 1915, Sept. 6, Dec. 5, 20, 21, 23, 24, 26–28, 1917, Feb. 10, 14, Mar. 3, and June 10, 1918. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920.*

[Drainage area, 1,600 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| **1914.** | | | | | |
| July 24–31 | ..... | ..... | 5.03 | 0.003 | 0.003 |
| August | 34 | 3.8 | 6.46 | .004 | .005 |
| September | 6,130 | 4.5 | 728 | .455 | .51 |
| **1914–15.** | | | | | |
| October | 330 | 24 | 74.4 | .046 | .05 |
| November | 31 | 21 | 24.9 | .016 | .02 |
| December | 38 | ..... | 26.8 | .017 | .02 |
| January | ..... | ..... | 373 | .233 | .27 |
| February | ..... | 435 | 2,170 | 1.36 | 1.42 |
| March | 470 | 130 | 257 | .161 | .19 |
| April | 150 | 69 | 123 | .077 | .09 |
| May | 5,650 | 44 | 616 | .385 | .44 |
| June | 5,510 | 160 | 664 | .415 | .46 |
| July | 5,510 | 215 | 1,280 | .800 | .92 |
| August | 8,200 | 130 | 1,750 | 1.09 | 1.26 |
| September 1–11 | ..... | ..... | 460 | .288 | .12 |
| **1915–16.** | | | | | |
| October | 1,620 | 65 | 313 | .196 | .23 |
| November | 1,670 | 76 | 281 | .176 | .20 |
| December | 745 | 190 | 478 | .299 | .34 |
| January | ..... | 745 | 5,500 | 3.44 | 3.97 |
| February | ..... | 595 | 2,060 | 1.29 | 1.39 |
| March | 5,650 | 375 | 1,100 | .688 | .79 |
| April | 3,100 | 555 | 1,200 | .750 | .84 |
| May | 4,820 | 375 | 1,600 | 1.00 | 1.15 |
| June | 4,880 | 685 | 1,800 | 1.12 | 1.25 |
| July | 1,070 | 30 | 325 | .203 | .23 |
| August | 1,120 | 45 | 190 | .119 | .14 |
| September | 820 | 44 | 195 | .122 | .14 |
| The year | ..... | 30 | 1,250 | .781 | 10.67 |
| **1916–17.** | | | | | |
| October | 555 | 37 | 165 | .103 | .12 |
| November | 595 | 135 | 251 | .157 | .18 |
| December | ..... | ..... | 261 | .163 | .19 |
| January | ..... | ..... | 805 | .503 | .58 |
| February | ..... | ..... | 206 | .129 | .13 |
| March | 9,700 | ..... | 1,810 | 1.13 | 1.30 |
| April | 2,860 | 315 | 942 | .589 | .66 |
| May | 4,120 | 300 | 910 | .569 | .66 |
| June | 13,400 | 685 | 3,990 | 2.49 | 2.78 |
| July | 1,810 | 65 | 689 | .431 | .50 |
| August | 970 | 65 | 262 | .164 | .19 |
| September | 3,170 | 65 | 792 | .495 | .55 |
| The year | 13,400 | 37 | 924 | .578 | 7.84 |
| **1917–18.** | | | | | |
| October | 2,660 | 77 | 984 | .615 | .71 |
| November | 1,140 | 96 | 424 | .265 | .30 |
| December | ..... | ..... | 152 | .095 | .11 |
| January 1–25 | ..... | ..... | 42.0 | .026 | .02 |
| February 8–28 | 7,560 | ..... | 2,370 | 1.48 | 1.16 |
| March | 2,910 | 270 | 793 | .496 | .57 |
| April | 1,620 | 285 | 959 | .599 | .67 |
| May | 3,920 | 315 | 1,230 | .769 | .89 |
| June | 5,440 | 130 | 1,240 | .775 | .86 |
| July 10–31 | 7,040 | 315 | 1,230 | .769 | .63 |
| August | 3,480 | 160 | 614 | .384 | .44 |
| September | 2,110 | 180 | 484 | .302 | .34 |

*Monthly discharge of Spoon River at Seville, Ill., for the years ending Sept. 30, 1914–1920*—Continued.

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,560 | 135 | 311 | 0.194 | 0.22 |
| November | 1,670 | 218 | 530 | .331 | .37 |
| December | 2,540 | 445 | 841 | .526 | .61 |
| January | | | 1,360 | .850 | .98 |
| February | 1,340 | 515 | 855 | .534 | .56 |
| March | 7,840 | 820 | 2,430 | 1.52 | 1.75 |
| April | 1,880 | 700 | 956 | .598 | .67 |
| May | 5,970 | 785 | 2,290 | 1.43 | 1.65 |
| June | 9,600 | 585 | 2,060 | 1.29 | 1.44 |
| July | 1,390 | 180 | 512 | .320 | .37 |
| August | 2,230 | 65 | 375 | .234 | .27 |
| September | 470 | 45 | 114 | .071 | .08 |
| The year | 9,600 | 45 | 1,060 | .662 | 8.97 |
| 1919–20. | | | | | |
| October | 418 | 65 | 185 | .116 | .13 |
| November | 1,340 | 130 | 353 | .221 | .25 |
| December | | | 329 | .206 | .24 |
| January | | | 115 | .072 | .08 |
| February | | | 586 | .366 | .39 |
| March | | | 2,210 | 1.38 | 1.59 |
| April | 11,000 | 890 | 3,150 | 1.97 | 2.20 |
| May | 5,300 | 890 | 2,440 | 1.52 | 1.75 |
| June | 2,700 | 188 | 691 | .432 | .48 |
| July | 1,820 | 63 | 260 | .162 | .19 |
| August | 300 | 32 | 70.7 | .044 | .05 |
| September | 50 | 27 | 32.8 | .020 | .02 |
| The year | 11,000 | 27 | 868 | .542 | 7.37 |

### SANGAMON RIVER AT MONTICELLO, ILL.

LOCATION.—In sec. 12, T. 18 N., R. 5 E. third principal meridian, at Illinois Central Railroad bridge half a mile west of Monticello, Piatt County.

DRAINAGE AREA.—550 square miles.

RECORDS AVAILABLE.—February 4, 1908, to December 31, 1912; June 23, 1914, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge and wooden trestle approach during medium and high stages, or by wading during low stages.

CHANNEL AND CONTROL.—Control composed of fine gravel; likely to shift. Measuring section is at a pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.15 feet at 5 p. m. June 25 (discharge, 7,370 second-feet); minimum stage, 1.7 feet September 9–19 (discharge, 5 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.85 feet April 22 (discharge, 7,960 second-feet); minimum stage, 1.8 feet October 1–4, August 23 to September 10 and September 22–25, 29, and 30 (discharge, 8 second-feet).

1908–1912 and 1914–1920: Maximum stage recorded, 15.2 feet May 14, 1908 (discharge, 9,280 second-feet); minimum stage, 1.5 feet July 31 to August 3, 1914 (discharge, 1.0 second-foot).

Maximum stage during flood of March to April, 1913, 17.7 feet March 25 (discharge not known).

ACCURACY.—Stage-discharge relation changed above 430 second-feet during high water of June, 1919, and March, 1920; slightly affected by ice during 1919; seriously affected by ice during 1920. Three rating curves used, all fairly well defined below 430 second-feet, and poorly defined above that point; applicable, respectively, October 1, 1918, to June 24, 1919, June 25, 1919, to February 29, 1920, and March 1 to September 30, 1920. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair for low and medium stages; poor for high stages; winter records poor.

*Discharge measurements of Sangamon River at Monticello, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 25 | H. C. Beckman | 3.53 | 131 | Aug. 11 | H. C. Beckman | 2.25 | 28 |
| 1919. | | | | 11 | do | 2.25 | 30 |
| May 21 | do | 3.87 | 167 | 1920. | | | |
| June 27 | do | 10.88 | 1,740 | Apr. 20 | H. J. Dean | 11.80 | 3,500 |

*Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 46 | 417 | 266 | 750 | 266 | 670 | 486 | 170 | 170 | 534 | 378 | 12 |
| 2 | 46 | 339 | 254 | 710 | 260 | 580 | 458 | 182 | 158 | 443 | 182 | 10 |
| 3 | 43 | 310 | 230 | 528 | 254 | 486 | 430 | 170 | 138 | 352 | 146 | 8 |
| 4 | 43 | 278 | 206 | | 242 | 514 | 417 | 200 | 138 | 302 | 110 | 8 |
| 5 | 40 | 206 | 182 | | 230 | 458 | 404 | 230 | 138 | 278 | 67 | 8 |
| 6 | 40 | 194 | 182 | | 182 | 444 | 390 | 230 | 138 | 242 | 56 | 8 |
| 7 | 40 | 182 | 158 | | 182 | 417 | 378 | 254 | 119 | 206 | 53 | 7 |
| 8 | 37 | 182 | 158 | | 158 | 378 | 352 | 254 | 110 | 182 | 43 | 6 |
| 9 | 37 | 206 | 148 | | 170 | 378 | 314 | 254 | 101 | 158 | 60 | 5 |
| 10 | 37 | 250 | 378 | 360 | 182 | 378 | 314 | 254 | 96 | 138 | 47 | 5 |
| 11 | 37 | 290 | 417 | | 182 | 404 | 302 | 248 | 92 | 119 | 34 | 5 |
| 12 | 37 | 278 | 542 | | 182 | 486 | 302 | 242 | 75 | 110 | 31 | 5 |
| 13 | 37 | 254 | 570 | | 206 | 570 | 290 | 230 | 71 | 101 | 34 | 5 |
| 14 | 37 | 230 | 730 | | 230 | 634 | 278 | 218 | 70 | 92 | 31 | 5 |
| 15 | 37 | 230 | 920 | | 230 | 1,190 | 266 | 206 | 68 | 83 | 28 | 5 |
| 16 | 40 | 230 | 1,110 | 278 | 330 | 2,500 | 266 | 194 | 67 | 79 | 28 | 5 |
| 17 | 40 | 230 | 1,350 | 278 | 430 | 3,820 | 242 | 182 | 67 | 71 | 30 | 5 |
| 18 | 40 | 230 | 960 | 278 | 404 | 4,650 | 230 | 165 | 83 | 67 | 31 | 5 |
| 19 | 40 | 230 | 750 | 272 | 404 | 4,370 | 230 | 148 | 138 | 60 | 22 | 5 |
| 20 | 40 | 200 | 710 | 266 | 352 | 3,820 | 218 | 158 | 106 | 55 | 20 | 8 |
| 21 | 40 | 170 | 990 | 254 | 352 | 3,170 | 206 | 158 | 92 | 50 | 56 | 9 |
| 22 | 34 | 165 | 1,280 | 254 | 365 | 1,570 | 206 | 164 | 92 | 46 | 31 | 10 |
| 23 | 34 | 158 | 1,570 | 266 | 385 | 1,340 | 182 | 170 | 92 | 40 | 22 | 12 |
| 24 | 60 | 138 | 1,890 | 290 | 404 | 1,110 | 182 | 230 | 182 | 37 | 20 | 17 |
| 25 | 71 | 128 | 2,060 | 314 | 500 | 930 | 170 | 290 | 7,370 | 31 | 17 | 25 |
| 26 | 92 | 119 | 1,820 | 314 | 586 | 800 | 158 | 352 | 2,280 | 29 | 17 | 12 |
| 27 | 260 | 119 | 1,690 | 314 | 690 | 750 | 158 | 302 | 1,770 | 27 | 17 | 10 |
| 28 | 430 | 148 | 1,450 | 314 | 670 | 670 | 158 | 242 | 1,390 | 25 | 17 | 10 |
| 29 | 458 | 170 | 1,160 | 302 | ..... | 570 | 158 | 206 | 1,140 | 92 | 17 | 10 |
| 30 | 634 | 194 | 875 | 278 | ..... | 550 | 170 | 182 | 880 | 60 | 14 | 10 |
| 31 | 570 | ..... | 800 | 278 | ..... | 528 | ..... | 182 | ..... | 56 | 13 | ..... |

*Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 8 | 456 | 1,200 | | 58 | 50 | 820 | 950 | 352 | 53 | 12 | 8 |
| 2 | 8 | 400 | 1,130 | | 67 | 46 | 770 | 1,000 | 302 | 53 | 12 | 8 |
| 3 | 8 | 339 | 980 | | 158 | 40 | 460 | 1,040 | 302 | 96 | 12 | 8 |
| 4 | 8 | 278 | 660 | | 278 | 138 | 445 | 1,040 | 290 | 86 | 12 | 8 |
| 5 | 65 | 230 | 521 | | 230 | 520 | 430 | 720 | 290 | 75 | 14 | 8 |
| 6 | 119 | 194 | 430 | | 182 | 320 | 404 | 600 | 296 | 56 | 14 | 8 |
| 7 | 83 | 194 | 405 | | 182 | 230 | 378 | 490 | 302 | 53 | 14 | 8 |
| 8 | 43 | 194 | 378 | 65 | 142 | 182 | 845 | 430 | 278 | 53 | 16 | 8 |
| 9 | 28 | 188 | 352 | | 101 | 254 | 980 | 400 | 242 | 53 | 17 | 8 |
| 10 | 23 | 182 | 302 | | 119 | 490 | 1,290 | 378 | 218 | 50 | 17 | 8 |
| 11 | 22 | 302 | 278 | | 138 | 895 | 1,200 | 352 | 206 | 50 | 17 | 14 |
| 12 | 20 | 378 | | | 170 | 1,750 | 1,120 | 2,090 | 182 | 50 | 12 | 14 |
| 13 | 17 | 339 | | | 206 | 2,090 | 980 | 2,090 | 170 | 50 | 12 | 14 |
| 14 | 17 | 302 | | | 218 | 2,300 | 870 | 1,610 | 158 | 158 | 12 | 17 |
| 15 | 17 | 254 | | | 180 | 2,500 | 820 | 1,490 | 128 | 71 | 12 | 22 |
| 16 | 17 | 218 | 190 | | | 2,000 | 680 | 1,900 | 128 | 53 | 12 | 25 |
| 17 | 17 | 182 | | | | 1,610 | 980 | 2,290 | 119 | 46 | 10 | 34 |
| 18 | 17 | 170 | | | | 1,390 | 1,920 | 5,150 | 110 | 45 | 10 | 17 |
| 19 | 14 | 158 | | | 90 | 1,120 | 2,850 | 3,750 | 101 | 43 | 10 | 14 |
| 20 | 12 | 138 | | | | 1,040 | 3,360 | 2,190 | 94 | 34 | 10 | 12 |
| 21 | 12 | 128 | | | | 980 | 6,970 | 1,910 | 88 | 31 | 10 | 10 |
| 22 | 12 | 128 | | | | 920 | 7,960 | 1,290 | 92 | 25 | 9 | 8 |
| 23 | 10 | 128 | | | | 745 | 5,900 | 1,100 | 92 | 25 | 8 | 8 |
| 24 | 10 | 128 | 115 | 50 | | 640 | 2,090 | 870 | 83 | 25 | 8 | 8 |
| 25 | 10 | 119 | | | | 720 | 1,690 | 720 | 75 | 24 | 8 | 8 |
| 26 | 16 | 119 | | | 50 | 1,750 | 1,290 | 600 | 71 | 22 | 8 | 12 |
| 27 | 22 | 119 | 110 | | | 2,090 | 1,040 | 520 | 69 | 17 | 8 | 17 |
| 28 | 365 | 119 | 110 | | | 2,090 | 980 | 430 | 67 | 17 | 8 | 12 |
| 29 | 430 | 302 | 110 | | | 2,090 | 980 | 378 | 53 | 12 | 8 | 8 |
| 30 | 365 | 805 | 101 | | ..... | 1,750 | 950 | 370 | 53 | 12 | 8 | 8 |
| 31 | 482 | ..... | 101 | | ..... | 1,200 | ..... | 361 | ..... | 12 | 8 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 4–15, Dec. 12–26, 1919, Jan. 1–31, Feb. 16–29, and Mar. 1, 6, and 7, 1920: discharge ascertained by means of gage heights, observer's notes, and weather records. Gage not read on Sundays; discharge interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Sangamon River at Monticello, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 550 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 634 | 37 | 112 | 0.204 | 0.24 |
| November | 417 | 119 | 216 | .393 | .44 |
| December | 2,060 | 148 | 832 | 1.51 | 1.74 |
| January | 750 | ..... | 350 | .636 | .73 |
| February | 690 | 158 | 322 | .585 | .61 |
| March | 4,650 | 378 | 1,260 | 2.29 | 2.64 |
| April | 486 | 158 | 277 | .504 | .56 |
| May | 352 | 148 | 215 | .391 | .45 |
| June | 7,370 | 67 | 581 | 1.06 | 1.18 |
| July | 534 | 25 | 134 | .244 | .28 |
| August | 378 | 13 | 53.9 | .098 | .11 |
| September | 25 | 5 | 8.5 | .015 | .02 |
| The year | 7,370 | 5 | 365 | .664 | 9.00 |
| 1919–20. | | | | | |
| October | 482 | 8 | 74.1 | .135 | .16 |
| November | 805 | 119 | 240 | .436 | .49 |
| December | 1,200 | ..... | 309 | .562 | .65 |
| January | ..... | ..... | 57.3 | .104 | .12 |
| February | 278 | ..... | 118 | .215 | .23 |
| March | 2,500 | 40 | 1,090 | 1.98 | 2.28 |
| April | 7,960 | 378 | 1,720 | 3.13 | 3.49 |
| May | 5,150 | 352 | 1,240 | 2.25 | 2.59 |
| June | 352 | 53 | 167 | .304 | .34 |
| July | 158 | 12 | 46.8 | .085 | .10 |
| August | 17 | 8 | 11.2 | .020 | .02 |
| September | 34 | 8 | 12.1 | .022 | .02 |
| The year | 7,960 | 8 | 424 | .771 | 10.49 |

### SANGAMON RIVER AT RIVERTON, ILL.

LOCATION.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridian, at Wabash Railroad bridge a quarter of a mile west of Riverton, Sangamon County, and 2½ miles below mouth of South Fork.

DRAINAGE AREA.—2,560 square miles.

RECORDS AVAILABLE.—February 13, 1908, to December 31, 1912; August 7, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by J. J. Washburn.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Control composed of fine gravel; shifting. Measuring section is at a pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 23.37 feet at 4.30 p. m. June 29 (discharge, 11,100 second-feet); minimum stage, 7.42 feet at 4.30 p. m. September 16 (discharge, 50 second-feet).

Maximum stage recorded during year ending September 30, 1920, 25.07 feet May 14 (discharge, 14,200 second-feet); minimum stage, 7.09 feet August 7 (discharge, 12 second-feet).

1908–1912 and 1914–1920: Maximum stage recorded, 27.8 feet February 3, 1916 (discharge, 20,800 second-feet); minimum stage, 6.9 feet October 3–15, 1914 (discharge, 3 second-feet).

Flood of 1883 reached a stage of about 32 feet on the present gage, and that of 1875 is said to have been one-half foot lower (discharge not determined).

ACCURACY.—Stage-discharge relation changed during high water of latter part of June, 1919, and again the latter part of March, 1920; affected by ice during winter 1919–20. Three rating curves used; the first and second applicable respectively, October 1, 1918, to June 30, 1919, and July 1, 1919, to March 28, 1920, are both fairly well defined above 30 second-feet and poorly defined below that point; the third, applicable March 29 to September 30, 1920, is fairly well defined between 30 and 4,000 second-feet, poorly defined below 30 second-feet, and extended above 4,000 second-feet on basis of shape of previous curve. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records poor.

*Discharge measurements of Sangamon River at Riverton, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 25 | H. C. Beckman | 9.64 | 440 | Sept. 14 | H. C. Beckman | 7.33 | 37 |
| 1919. | | | | 1920. | | | |
| Aug. 11 | do | 8.92 | 325 | Apr. 15 | H. J. Dean | 17.16 | 3,560 |
| Sept. 14 | do | 7.32 | 35 | | | | |

*Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 162 | 1,100 | 570 | 4,020 | 717 | 1,740 | 2,080 | 570 | 780 | 9,280 | 568 | 78 |
| 2 | 162 | 950 | 542 | 3,720 | 717 | 1,740 | 1,780 | 570 | 950 | 6,010 | 540 | 73 |
| 3 | 144 | 880 | 748 | 2,660 | 687 | 1,740 | 1,640 | 598 | 2,330 | 5,610 | 486 | 72 |
| 4 | 135 | 846 | 598 | 2,440 | 542 | 1,690 | 1,600 | 598 | 4,020 | 4,420 | 486 | 67 |
| 5 | 126 | 1,020 | 515 | 2,340 | 464 | 1,600 | 1,510 | 627 | 6,680 | 2,780 | 435 | 67 |
| 6 | 110 | 1,020 | 515 | 2,230 | 439 | 1,460 | 1,420 | 598 | 6,930 | 2,680 | 386 | 62 |
| 7 | 110 | 1,100 | 515 | 2,030 | 439 | 1,340 | 1,260 | 687 | 6,340 | 2,320 | 386 | 59 |
| 8 | 110 | 950 | 515 | 1,840 | 439 | 1,060 | 1,460 | 813 | 5,070 | 1,870 | 342 | 59 |
| 9 | 110 | 748 | 489 | 1,640 | 414 | 1,100 | 1,100 | 880 | 3,660 | 1,540 | 342 | 58 |
| 10 | 110 | 627 | 464 | 1,510 | 326 | 1,060 | 1,060 | 915 | 2,820 | 1,260 | 300 | 58 |
| 11 | 110 | 627 | 390 | 1,380 | 326 | 1,060 | 950 | 950 | 1,460 | 1,150 | 321 | 56 |
| 12 | 110 | 627 | 1,300 | 1,360 | 326 | 1,020 | 880 | 985 | 1,100 | 976 | 280 | 54 |
| 13 | 102 | 627 | 2,080 | 1,340 | 347 | 1,020 | 880 | 985 | 880 | 1,040 | 240 | 54 |
| 14 | 102 | 598 | 2,280 | 1,230 | 542 | 1,180 | 846 | 985 | 542 | 844 | 210 | 53 |
| 15 | 99 | 598 | 2,230 | 1,120 | 780 | 2,380 | 780 | 915 | 542 | 656 | 181 | 52 |
| 16 | 94 | 598 | 2,330 | 1,020 | 748 | 2,540 | 717 | 813 | 687 | 717 | 181 | 50 |
| 17 | 94 | 570 | 2,180 | 950 | 717 | 4,020 | 687 | 627 | 1,140 | 540 | 190 | 52 |
| 18 | 96 | 570 | 2,330 | 880 | 780 | 4,840 | 687 | 570 | 748 | 486 | 172 | 53 |
| 19 | 92 | 570 | 2,380 | 880 | 780 | 6,220 | 687 | 542 | 813 | 460 | 163 | 54 |
| 20 | 91 | 542 | 2,380 | 813 | 813 | 6,680 | 687 | 570 | 950 | 435 | 163 | 59 |
| 21 | 91 | 515 | 2,380 | 846 | 915 | 6,930 | 687 | 598 | 1,180 | 435 | 172 | 70 |
| 22 | 88 | 464 | 2,380 | 813 | 950 | 8,010 | 687 | 598 | 1,260 | 364 | 163 | 95 |
| 23 | 88 | 464 | 3,260 | 780 | 950 | 8,010 | 687 | 598 | 1,740 | 342 | 154 | 100 |
| 24 | 86 | 414 | 3,900 | 780 | 950 | 7,720 | 657 | 748 | 3,370 | 321 | 154 | 105 |
| 25 | 200 | 414 | 4,080 | 748 | 950 | 7,450 | 570 | 846 | 4,490 | 300 | 154 | 112 |
| 26 | 218 | 368 | 4,080 | 780 | 1,060 | 5,520 | 542 | 950 | 5,800 | 260 | 138 | 112 |
| 27 | 247 | 368 | 4,210 | 748 | 1,880 | 4,770 | 515 | 985 | 7,450 | 250 | 129 | 107 |
| 28 | 285 | 390 | 4,210 | 748 | 1,980 | 4,140 | 542 | 985 | 10,300 | 250 | 104 | 86 |
| 29 | 464 | 489 | 4,210 | 748 | ..... | 3,100 | 570 | 950 | 11,100 | 260 | 81 | 67 |
| 30 | 489 | 464 | 4,210 | 748 | ..... | 2,760 | 598 | 813 | 10,500 | 280 | 80 | 62 |
| 31 | 627 | ..... | 3,780 | 748 | ..... | 2,180 | ..... | 813 | ..... | 568 | 78 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 58 | 4,490 | 3,440 | | 1,260 | 748 | 7,460 | 3,120 | 4,210 | 285 | 59 | 64 |
| 2 | 54 | 5,330 | 3,900 | | 1,300 | 435 | 6,440 | 2,570 | 9,230 | 285 | 56 | 44 |
| 3 | 54 | 5,610 | 3,280 | | 1,340 | 410 | 5,870 | 3,660 | 9,560 | 285 | 40 | 39 |
| 4 | 52 | 4,990 | 3,280 | | 1,420 | 386 | 4,660 | 3,540 | 8,450 | 285 | 24 | 37 |
| 5 | 47 | 4,630 | 3,220 | | 1,420 | 943 | 3,540 | 3,270 | 7,460 | 266 | 14 | 37 |
| 6 | 59 | 3,960 | 2,730 | | 1,220 | 1,460 | 3,070 | 2,570 | 7,320 | 266 | 12 | 36 |
| 7 | 62 | 3,500 | 2,570 | | 1,150 | 1,220 | 3,220 | 2,280 | 5,300 | 266 | 12 | 33 |
| 8 | 70 | 3,120 | 2,520 | | 1,120 | 1,220 | 3,660 | 2,060 | 3,720 | 247 | 12 | 34 |
| 9 | 65 | 2,680 | 2,520 | | 976 | 1,300 | 4,210 | 1,740 | 2,420 | 247 | 12 | 39 |
| 10 | 73 | 2,730 | 2,470 | | 943 | 1,340 | 4,350 | 1,490 | 2,060 | 285 | 13 | 66 |
| 11 | 95 | 3,390 | 2,470 | | 812 | 1,820 | 4,420 | 1,410 | 1,920 | 285 | 15 | 180 |
| 12 | 112 | 3,610 | 2,420 | 375 | 656 | 6,800 | 4,140 | 7,730 | 1,450 | 285 | 82 | 190 |
| 13 | 107 | 3,560 | 2,320 | | 597 | 7,320 | 4,420 | 7,730 | 1,210 | 285 | 102 | 209 |
| 14 | 102 | 3,280 | 1,380 | | 540 | 7,580 | 3,780 | 14,200 | 1,060 | 266 | 200 | 200 |
| 15 | 105 | 3,220 | | | 513 | 7,580 | 3,600 | 10,300 | 915 | 266 | 368 | 171 |
| 16 | 112 | 2,840 | | | 540 | 7,450 | 3,780 | 9,730 | 880 | 247 | 717 | 153 |
| 17 | 120 | 2,320 | | | 626 | 7,450 | 4,280 | 10,100 | 780 | 218 | 390 | 126 |
| 18 | 112 | 1,870 | 800 | | 626 | 7,450 | 4,580 | 11,400 | 657 | 266 | 247 | 86 |
| 19 | 104 | 1,380 | | | 626 | 7,860 | 5,100 | 11,000 | 598 | 228 | 153 | 53 |
| 20 | 83 | 1,260 | | | 780 | 8,010 | 7,730 | 10,600 | 570 | 200 | 171 | 52 |
| 21 | 70 | 1,180 | | | 1,150 | 7,860 | 8,450 | 10,100 | 542 | 180 | 200 | 47 |
| 22 | 67 | 1,040 | 705 | | 1,180 | 6,800 | 7,870 | 9,400 | 542 | 144 | 209 | 39 |
| 23 | 67 | 976 | 695 | 320 | 1,340 | 6,560 | 7,320 | 8,910 | 542 | 110 | 110 | 33 |
| 24 | 64 | 943 | 686 | 300 | 1,580 | 5,160 | 7,190 | 7,730 | 542 | 102 | 71 | 30 |
| 25 | 62 | 717 | 676 | 280 | 2,020 | 5,700 | 7,190 | 7,590 | 542 | 102 | 59 | 28 |
| 26 | 62 | 686 | 666 | 321 | 1,700 | 8,780 | 7,590 | 7,060 | 464 | 92 | 48 | 26 |
| 27 | 220 | 656 | 656 | 386 | 1,120 | 9,100 | 6,680 | 5,870 | 414 | 86 | 44 | 135 |
| 28 | 748 | 812 | 626 | 597 | 626 | 9,620 | 5,870 | 4,420 | 347 | 74 | 41 | 118 |
| 29 | 2,220 | 2,950 | 616 | 844 | 626 | 9,070 | 4,660 | 3,270 | 326 | 74 | 40 | 110 |
| 30 | 3,610 | 3,220 | 607 | 1,220 | ..... | 8,450 | 3,540 | 3,170 | 305 | 68 | 48 | 89 |
| 31 | 4,140 | ..... | 597 | 1,260 | ..... | 8,010 | ..... | 3,170 | ..... | 64 | 56 | ..... |

NOTE.—Stage-discharge relation affected by ice, Dec. 15–21, 1919, and Jan. 1–22, 1920; discharge ascertained by means of gage heights, observer's notes, and weather records. Discharge interpolated on account of lack of gage readings, Jan. 5, 7, 8, 10, 12, 14, 15, 17, Dec. 22, 23, 25, 26, 29, 30, 1919, and Jan. 23, 1920.

*Monthly discharge of Sangamon River at Riverton, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,560 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 627 | 86 | 166 | 0.065 | 0.07 |
| November | 1,100 | 368 | 651 | .254 | .28 |
| December | 4,210 | 390 | 2,130 | .832 | .96 |
| January | 4,020 | 748 | 1,420 | .555 | .64 |
| February | 1,980 | 326 | 749 | .293 | .31 |
| March | 8,010 | 1,020 | 3,420 | 1.34 | 1.54 |
| April | 2,080 | 515 | 959 | .375 | .42 |
| May | 985 | 542 | 764 | .298 | .34 |
| June | 11,100 | 542 | 3,520 | 1.38 | 1.54 |
| July | 9,280 | 250 | 1,570 | .613 | .71 |
| August | 568 | 78 | 251 | .098 | .11 |
| September | 112 | 50 | 70.2 | .027 | .03 |
| The year | 11,100 | 50 | 1,310 | .512 | 6.95 |
| 1919-20. | | | | | |
| October | 4,140 | 47 | 419 | .164 | .19 |
| November | 5,610 | 656 | 2,700 | 1.05 | 1.17 |
| December | 3,900 | 597 | 1,630 | .637 | .73 |
| January | 1,260 | ..... | 444 | .173 | .20 |
| February | 2,020 | 513 | 1,030 | .402 | .43 |
| March | 9,620 | 386 | 5,290 | 2.07 | 2.39 |
| April | 8,450 | 3,070 | 5,290 | 2.07 | 2.31 |
| May | 14,200 | 1,410 | 6,170 | 2.41 | 2.78 |
| June | 9,560 | 305 | 2,480 | .969 | 1.08 |
| July | 285 | 64 | 205 | .080 | .09 |
| August | 717 | 12 | 117 | .046 | .05 |
| September | 209 | 26 | 83.5 | .033 | .04 |
| The year | 14,200 | 12 | 2,160 | .844 | 11.46 |

### SANGAMON RIVER NEAR OAKFORD, ILL.

LOCATION.—In sec. 6, T. 19 N., R. 7 W. third principal meridian, at highway bridge 3 miles northeast of Oakford, Menard County, 2½ miles above Chicago, Peoria & St. Louis Railway bridge, and 1¼ miles above mouth of Crane Creek.

DRAINAGE AREA.—5,000 square miles.

RECORDS AVAILABLE.—October 26, 1909, to June 30, 1911; December 10, 1911, to March 31, 1912; and August 25, 1914, to June 11, 1919, when station was discontinued.

GAGE.—Chain gage attached to bridge; read by Henry Chesser.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and fine gravel; shifting. The river for some distance above and below station has been dredged and straightened, thus increasing the slope considerably and disturbing the regimen of flow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 13.15 feet at 4.30 p. m. March 21 (discharge, 11,900 second-feet); minimum stage, 1.25 feet at 4.30 p. m. October 20 (discharge, 173 second-feet).

1909–1912 and 1914–1919: Maximum discharge recorded, 33,300 second-feet June 8 and 9, 1917 (determined from extension of rating curve); minimum discharge recorded, 85 second-feet August 30 and 31, November 28, and December 2, 1914.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records good; winter records poor.

*Discharge measurements of Sangamon River near Oakford, Ill., during the year ending Sept. 30, 1919.*

[Made by H. C. Beckman.]

| Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. | Date. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|---|
| | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* | | *Feet.* | *Sec.-ft.* |
| Nov. 23 | 2.89 | 1,010 | Apr. 1 | 7.80 | 4,880 | Aug. 9 | 3.11 | 1,020 |

*Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the period Oct. 1, 1918, to June 11, 1919.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 476 | 1,950 | 1,320 | 5,930 | 1,600 | 3,060 | 4,330 | 1,320 | 1,930 |
| 2 | 452 | 1,950 | 1,670 | 5,820 | 1,530 | 2,940 | 3,950 | 1,390 | 1,950 |
| 3 | 405 | 1,390 | 1,260 | 5,600 | 1,460 | 2,820 | 3,680 | 1,390 | 2,740 |
| 4 | 405 | 1,390 | 1,200 | | 1,390 | 2,740 | 3,500 | 1,420 | 7,000 |
| 5 | 405 | 1,140 | 1,200 | | 1,390 | 2,580 | 3,320 | 1,460 | 7,910 |
| 6 | 382 | 1,020 | 1,140 | | 1,320 | 2,420 | 3,150 | 1,600 | 7,910 |
| 7 | 337 | 1,080 | 1,080 | 4,670 | 1,260 | 2,260 | 2,980 | 1,810 | 7,780 |
| 8 | 294 | 906 | 1,050 | | 1,200 | 2,100 | 2,820 | 2,020 | 7,330 |
| 9 | 294 | 1,020 | 1,020 | | 1,140 | 2,100 | 2,740 | 2,180 | 6,880 |
| 10 | 294 | 1,880 | 962 | | 1,080 | 2,100 | 2,500 | 2,260 | 5,490 |
| 11 | 337 | 1,390 | 906 | | 1,140 | 2,020 | 2,420 | 2,220 | 4,040 |
| 12 | 294 | 1,390 | 906 | | 1,140 | 2,420 | 2,340 | 2,180 | ..... |
| 13 | 696 | 1,460 | 1,020 | | 1,200 | 2,980 | 2,260 | 2,100 | ..... |
| 14 | 337 | 1,320 | 1,080 | | 1,260 | 3,500 | 2,180 | 1,880 | ..... |
| 15 | 337 | 1,200 | 1,480 | 3,090 | 1,390 | 3,680 | 2,100 | 1,740 | ..... |
| 16 | 210 | 1,260 | 1,880 | | 1,460 | 5,660 | 2,020 | 1,670 | ..... |
| 17 | 210 | 1,200 | 2,420 | | 1,530 | 7,650 | 1,950 | 1,530 | ..... |
| 18 | 251 | 1,140 | 2,820 | | 1,600 | 9,920 | 1,880 | 1,530 | ..... |
| 19 | 251 | 1,140 | 2,980 | | 1,670 | 11,000 | 1,810 | 1,530 | ..... |
| 20 | 173 | 1,020 | 3,060 | 2,180 | 1,670 | 11,800 | 1,740 | 1,460 | ..... |
| 21 | 210 | 1,020 | 3,230 | 2,020 | 1,740 | 11,900 | 1,670 | 1,460 | ..... |
| 22 | 251 | 1,020 | 3,410 | 1,950 | 1,810 | 11,500 | 1,600 | 1,460 | ..... |
| 23 | 337 | 962 | 3,590 | 1,810 | 1,880 | 11,200 | 1,600 | 1,460 | ..... |
| 24 | 210 | 906 | 4,330 | 1,740 | 1,950 | 9,640 | 1,530 | 1,810 | ..... |
| 25 | 251 | 851 | 5,050 | 1,670 | 2,100 | 9,640 | 1,530 | 2,000 | ..... |
| 26 | 337 | 851 | 5,710 | 1,640 | 2,340 | 9,220 | 1,390 | 2,180 | ..... |
| 27 | 696 | 798 | 6,040 | 1,600 | 2,980 | 8,820 | 1,360 | 2,180 | ..... |
| 28 | 798 | 906 | 6,040 | 1,670 | 3,140 | 7,650 | 1,320 | 2,180 | ..... |
| 29 | 798 | 962 | 6,040 | 1,600 | ..... | 6,760 | 1,260 | 2,020 | ..... |
| 30 | 1,020 | 962 | 6,040 | 1,670 | ..... | 5,850 | 1,390 | 1,960 | ..... |
| 31 | 1,390 | ..... | 6,160 | 1,530 | ..... | 4,940 | ..... | 1,880 | ..... |

NOTE.—Stage-discharge relation seriously affected by ice Jan. 4–19; mean discharge ascertained by means of gage heights, observer's notes, and weather records. Gage not read on Sundays beginning Nov. 17; discharge interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Sangamon River near Oakford, Ill., for the period Oct. 1, 1918, to June 11, 1919.*

[Drainage area, 5,000 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| October | 1,390 | 173 | 424 | 0.085 | 0.10 |
| November | 1,950 | 798 | 1,180 | .236 | .26 |
| December | 6,160 | 906 | 2,780 | .556 | .64 |
| January | ..... | 1,530 | 3,190 | .638 | .74 |
| February | 3,140 | 1,060 | 1,620 | .324 | .34 |
| March | 11,900 | 2,020 | 5,900 | 1.18 | 1.36 |
| April | 4,330 | 1,260 | 2,280 | .456 | .51 |
| May | 2,260 | 1,320 | 1,780 | .356 | .41 |
| June 1–11 | 7,910 | 1,920 | 5,540 | 1.11 | .45 |

**SOUTH FORK OF SANGAMON RIVER AT POWER PLANT, NEAR TAYLORVILLE, ILL.**

LOCATION.—In sec. 14, T. 13 N., R. 3 W., at Chicago & Illinois Midland Railroad bridge, 6 miles northwest of Taylorville, Christian County, 500 feet east of power plant of Central Illinois Public Service Co., 5 miles below mouth of Bear Creek, and 8 miles below station formerly maintained at Wabash Railroad bridge.

DRAINAGE AREA.—510 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 18, 1917, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by employees of Central Illinois Public Service Co.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of soft mud; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 16.11 feet June 26 and 27 (discharge, 2,150 second-feet); minimum stage, 3.37 feet September 11, 12, and 14 (discharge, 1.0 second-foot).

Maximum stage recorded during year ending September 30, 1920, 19.5 feet May 19 (discharge, 4,800 second-feet); minimum stage, 3.40 feet August 11 and 12 and September 26 (discharge, 3.0 second-feet).

1917–1920: Maximum stage recorded, 26.6 feet June 6, 1917 (discharge, 10,400 second-feet); minimum stage, 3.37 feet September 11, 12, and 14, 1919 (discharge, 1.0 second-foot); discharge during latter part of January, 1918, probably somewhat less than 1.0 second-foot.

A stage of about 27.3 feet on present gage is said to have been reached January 31, 1916 (discharge, 11,300 second-feet).

DIVERSIONS.—On an average, about half a second-foot of water is used for boiler feed and other purposes at the power plant.

ACCURACY.—Low-water stage-discharge relation changed slightly during August, 1919, and May, 1920; high-water stage-discharge relation changed considerably during fall of 1919 on account of replacing pile-trestle approach to railway bridge with through girder spans, and by clearing at approaches. Stage-discharge relation seriously affected by ice for short periods during winter and by a log and drift jam below gage during period February to May, 1920. Three fairly well defined rating curves used, applicable respectively, October 1, 1918, to August 19, 1919; September 20 to December 31, 1919; January 1 to September 30, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Open-water records fair except for period during which log and drift jam occurred for which they are poor; winter records poor.

*Discharge measurements of South Fork of Sangamon River at power plant, near Taylorville, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 22 | H. C. Beckman | 5.58 | 107 | Sept. 15 | H. C. Beckman | 3.39 | 1.0 |
| | | | | 15 | do | 3.39 | 1.1 |
| 1919. | | | | Nov. 24 | H. J. Dean | 7.22 | 227 |
| Mar. 13 | do | a 7.00 | 252 | | | | |
| Aug. 12 | do | 4.00 | 14.1 | 1920. | | | |
| 12 | do | 4.00 | 15.1 | May 19 | do | 19.21 | 4,550 |

a Gage height determined at later date and probably in error.

*Daily discharge, in second-feet, of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 36 | 277 | 240 | | 125 | 327 | 218 | 90 | 150 | 584 | 24 | 2.2 |
| 2 | 31 | 195 | 204 | | 117 | 240 | 213 | 104 | 177 | 297 | 27 | 2.5 |
| 3 | 29 | 160 | 177 | | 109 | 231 | 195 | 118 | 150 | 231 | 27 | 2.2 |
| 4 | 27 | 125 | 150 | | 109 | 213 | 177 | 133 | 733 | 213 | 25 | 2.2 |
| 5 | 27 | 109 | 141 | | 101 | 204 | 177 | 150 | 1,950 | 159 | 24 | 2.0 |
| 6 | 24 | 97 | 125 | 240 | 97 | 195 | 159 | 307 | 1,990 | 680 | 19 | 2.0 |
| 7 | 22 | 97 | 109 | | 81 | 177 | 159 | 327 | 1,830 | 614 | 20 | 1.7 |
| 8 | 20 | 109 | 101 | | 73 | 159 | 159 | 213 | 1,500 | 489 | 36 | 1.5 |
| 9 | 19 | 125 | 93 | | 66 | 168 | 150 | 267 | 868 | 467 | 40 | 1.5 |
| 10 | 19 | 159 | 97 | | 66 | 189 | 150 | 417 | 377 | 231 | 22 | 1.1 |
| 11 | 19 | 150 | 97 | 177 | 66 | 210 | 141 | 357 | 258 | 168 | 20 | 1.0 |
| 12 | 20 | 141 | 93 | 177 | 66 | 231 | 141 | 267 | 195 | 150 | 14 | 1.0 |
| 13 | 21 | 141 | 101 | 177 | 101 | 252 | 125 | 195 | 168 | 117 | 14 | 1.0 |
| 14 | 19 | 141 | 347 | 177 | 141 | 388 | 109 | 159 | 168 | 101 | 13 | 1.0 |
| 15 | 18 | 141 | 557 | 159 | 168 | 524 | 117 | 133 | 168 | 89 | 19 | 1.1 |
| 16 | 19 | 133 | 733 | 150 | 186 | 660 | 109 | 125 | 186 | 77 | 33 | 1.1 |
| 17 | 18 | 133 | 715 | 150 | 195 | 796 | 109 | 297 | 177 | 66 | 38 | 1.1 |
| 18 | 19 | 125 | 680 | 150 | 195 | 935 | 101 | 109 | 141 | 62 | 33 | 1.1 |
| 19 | 16 | 125 | 533 | 141 | 177 | 1,320 | 97 | 101 | 133 | 58 | 36 | 1.5 |
| 20 | 16 | 125 | 387 | 141 | 159 | 1,530 | 93 | 101 | 599 | 55 | 20 | 2.5 |
| 21 | 18 | 117 | 347 | 141 | 177 | 1,560 | 89 | 109 | 427 | 49 | 12 | 2.0 |
| 22 | 18 | 109 | 467 | 141 | 195 | 1,500 | 85 | 133 | 511 | 43 | 10 | 73 |
| 23 | 18 | 97 | 646 | 141 | 258 | 1,200 | 85 | 168 | 522 | 40 | 8.0 | 62 |
| 24 | 22 | 89 | 787 | 159 | 307 | 751 | 81 | 204 | 1,530 | 38 | 10 | 43 |
| 25 | 46 | 73 | 1,020 | 159 | 367 | 457 | 77 | 204 | 1,790 | 31 | 8.0 | 21 |
| 26 | 73 | 73 | 1,080 | 150 | 489 | 367 | 69 | 213 | 2,150 | 29 | 6.0 | 9.0 |
| 27 | 133 | 66 | 1,080 | 150 | 467 | 337 | 69 | 186 | 2,150 | 25 | 4.0 | 6.5 |
| 28 | 177 | 81 | 1,050 | 141 | 367 | 297 | 73 | 240 | 1,990 | 22 | 3.0 | 9.0 |
| 29 | 357 | 141 | 847 | 133 | ..... | 240 | 62 | 240 | 1,410 | 20 | 3.0 | 14 |
| 30 | 427 | 195 | 557 | 125 | ..... | 240 | 76 | 213 | 1,200 | 20 | 2.5 | 14 |
| 31 | 407 | ..... | 387 | 125 | ..... | 222 | ..... | 177 | ..... | 22 | 2.2 | ..... |
| 1919–20. | | | | | | | | | | | | |
| 1 | 10 | 2,270 | 826 | 70 | 456 | 62 | 868 | 155 | 417 | 49 | 9 | 18 |
| 2 | 7 | 2,270 | 826 | | 511 | 146 | 511 | 478 | 3,390 | 46 | 9 | 14 |
| 3 | 6 | 2,030 | 787 | | 663 | 124 | 468 | 915 | 3,920 | 43 | 9 | 13 |
| 4 | 5 | 1,790 | 715 | | 680 | 290 | 425 | 697 | 2,780 | 39 | 9 | 10 |
| 5 | 4 | 1,630 | 511 | 50 | 533 | 445 | 382 | 478 | 2,420 | 35 | 8 | 9 |
| 6 | 6 | 1,440 | 320 | | 423 | 511 | 340 | 300 | 1,590 | 31 | 8 | 8 |
| 7 | 7 | 1,200 | 310 | | 390 | 445 | 511 | 240 | 1,020 | 86 | 8 | 7 |
| 8 | 7 | 1,260 | 300 | | 320 | 280 | 680 | 182 | 522 | 141 | 6 | 6 |
| 9 | 6 | 1,380 | | | 280 | 300 | 680 | 164 | 367 | 66 | 6 | 5 |
| 10 | 9 | 1,500 | 200 | 43 | 390 | 330 | 680 | 146 | 387 | 81 | 4 | 4 |
| 11 | 19 | 1,560 | | 40 | 340 | 733 | 630 | 137 | 249 | 109 | 3 | 8 |
| 12 | 46 | 1,560 | | 43 | 280 | 1,300 | 557 | 1,710 | 222 | 101 | 3 | 109 |
| 13 | 38 | 1,320 | 182 | 43 | 230 | 2,000 | 445 | 1,830 | 186 | 109 | 20 | 213 |
| 14 | 17 | 1,180 | 128 | 46 | 200 | 2,360 | 390 | 1,870 | 177 | 52 | 141 | 69 |
| 15 | 11 | 1,100 | 116 | 44 | 182 | 2,200 | 330 | 2,100 | 141 | 52 | 55 | 38 |
| 16 | 8 | 826 | 120 | 43 | 92 | 2,000 | 300 | 1,830 | 133 | 49 | 29 | 25 |
| 17 | 7 | 533 | 112 | 43 | | 1,670 | 300 | 2,100 | 125 | 40 | 213 | 6 |
| 18 | 7 | 340 | 100 | 43 | 105 | 1,590 | 310 | 3,040 | 109 | 31 | 89 | 13 |
| 19 | 6 | 300 | 92 | 41 | | 1,590 | 320 | 4,800 | 97 | 27 | 33 | 16 |
| 20 | 6 | 280 | 80 | 40 | | 1,440 | 445 | 3,880 | 93 | 24 | 20 | 13 |
| 21 | 5 | 250 | 73 | 38 | 340 | 1,330 | 570 | 2,970 | 85 | 22 | 7 | 10 |
| 22 | 5 | 240 | 73 | 35 | 760 | 1,240 | 489 | 2,150 | 85 | 22 | 8 | 16 |
| 23 | 4 | 220 | 73 | 34 | 1,180 | 1,060 | 380 | 1,330 | 101 | 20 | 8 | 9 |
| 24 | 4 | 220 | 73 | 33 | 1,180 | 895 | 290 | 1,240 | 101 | 18 | 7 | 6 |
| 25 | 3 | 220 | 73 | 32 | 915 | 715 | 230 | 1,150 | 97 | 14 | 8 | 5 |
| 26 | 7 | 210 | 70 | 30 | 330 | 1,910 | 200 | 1,040 | 81 | 13 | 8 | 3 |
| 27 | 21 | 164 | 73 | 35 | 128 | 2,480 | 191 | 1,180 | 69 | 12 | 8 | 5 |
| 28 | 806 | 146 | 76 | 70 | 200 | 3,460 | 182 | 1,040 | 58 | 12 | 7 | 6 |
| 29 | 1,870 | 220 | 70 | 92 | 130 | 2,780 | 173 | 769 | 52 | 8 | 7 | 6 |
| 30 | 2,270 | 467 | 66 | 146 | ..... | 2,000 | 164 | 467 | 49 | 9 | 7 | 8 |
| 31 | 2,310 | ..... | 70 | 401 | ..... | 1,440 | ..... | 337 | ..... | 9 | 6 | ..... |

NOTE.—Stage-discharge relation affected by ice Jan. 1–10, Dec. 9–12, 1919, Jan. 2–9, and Feb. 17–20, 1920; discharge ascertained by means of gage heights, observer's notes, and weather records. Indirect method for shifting control used Aug. 20 to Sept. 19, 1919, and Nov. 21, 1919, to Feb. 25, 1920. Correction, estimated at 0.3 foot, applied to gage heights during period Feb. 26 to May 15, 1920, on account of backwater from log and drift jam below gage. Gage not read Mar. 13, 1919; discharge ascertained by current-meter measurements. Gage not read Mar. 10–12, 14–17, Apr. 1, Apr. 30 to May 3, Sept. 17–19, Dec. 7, 1919, Jan. 23, 24, Feb. 1, 22, 29, Mar. 24, Apr. 3–5, 20, May 20, July 4, 5, 7, 20, Aug. 1, 2, 4, 5, 10, 20, 22, Sept. 6–9, 20, 1920; discharge interpolated. Braced figures show mean discharge for periods indicated.

*Monthly discharge of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 510 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 427 | 16 | 68.9 | 0.135 | 0.16 |
| November | 277 | 66 | 128 | .251 | .28 |
| December | 1,080 | 93 | 450 | .882 | 1.02 |
| January | ..... | 125 | 179 | .351 | .40 |
| February | 489 | 66 | 179 | .351 | .37 |
| March | 1,560 | 159 | 520 | 1.02 | 1.18 |
| April | 218 | 62 | 122 | .239 | .27 |
| May | 417 | 90 | 195 | .382 | .44 |
| June | 2,150 | 133 | 853 | 1.67 | 1.86 |
| July | 584 | 20 | 169 | .331 | .38 |
| August | 40 | 2.2 | 18.5 | .036 | .04 |
| September | 73 | 1.0 | 9.73 | .019 | .02 |
| The year | 2,150 | 1.0 | 241 | .473 | 6.42 |
| 1919–20. | | | | | |
| October | 2,310 | 3 | 243 | .476 | .55 |
| November | 2,270 | 146 | 938 | 1.84 | 2.05 |
| December | 826 | 66 | 230 | .451 | .52 |
| January | 401 | 30 | 60.8 | .119 | .14 |
| February | 1,180 | 92 | 412 | .808 | .87 |
| March | 3,460 | 62 | 1,260 | 2.47 | 2.85 |
| April | 868 | 164 | 415 | .814 | .91 |
| May | 4,800 | 137 | 1,310 | 2.57 | 2.96 |
| June | 3,920 | 49 | 637 | 1.25 | 1.40 |
| July | 141 | 8 | 44.2 | .087 | 1.10 |
| August | 213 | 3 | 24.6 | .048 | .06 |
| September | 213 | 3 | 22.6 | .044 | .05 |
| The year | 4,800 | 3 | 466 | .914 | 12.46 |

## KASKASKIA RIVER AT VANDALIA, ILL.

LOCATION.—In sec. 16, T. 6 N., R. 1 E. third principal meridian, at highway bridge at east end of Main Street, Vandalia, Fayette County, 3½ miles above Hickory Creek.

DRAINAGE AREA.—1,980 square miles.

RECORDS AVAILABLE.—February 26, 1908, to December 31, 1912; August 11, 1914, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by Wilson Haley.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; clean; likely to shift. Measuring section in a pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 20.1 feet at 1 p. m. March 19 (discharge, 11,000 second-feet); minimum stage, 0.86 foot at 1 p. m. September 18 (discharge, 37 second-feet).

Maximum stage recorded during year ending September 30, 1920, 21.0 feet May 19 (discharge, 12,600 second-feet); minimum stage, 0.86 foot October 25 (discharge, 36 second-feet).

1908–1912; 1914–1920: Maximum stage recorded, 23.0 feet June 6, 1917 (discharge, 16,400 second-feet); minimum discharge, 3.5 second-feet August 22, 1911.

ACCURACY.—Stage-discharge relation changed during high water in March, 1919, and March, 1920; seriously affected by ice January 5–17, 1919. Three rating curves used; the first, applicable October 1, 1918, to March 26, 1919, well defined above 200 second-feet and extended below that point; the second, applicable March 27, 1919, to March 15, 1920, well defined below 11,000 second-feet; the third, applicable, March 16 to September 30, 1920, well defined above 330 second-feet and extended below that point. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for days when gage was not read, and except for period when stage-discharge relation was affected by ice for which mean discharge was ascertained by means of gage heights, observer's notes, and weather record. Open-water records good; winter records poor.

*Discharge measurements of Kaskaskia River at Vandalia, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Mar. 12 | H. C. Beckman | 7.52 | 1,660 | Nov. 22 | H. J. Dean | 5.82 | 934 |
| Aug. 13 | do | 2.19 | 163 | | | | |
| Sept. 17 | do | .90 | 39 | 1920. | | | |
| | | | | Apr. 17 | do | 8.00 | 1,880 |

*Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918–19. | | | | | | | | | | | | |
| 1 | 470 | 1,580 | 1,230 | 3,200 | 659 | 1,440 | 1,260 | 380 | 695 | 6,460 | 417 | 109 |
| 2 | 448 | 1,400 | 1,110 | 3,840 | 634 | 1,360 | 1,150 | 398 | 616 | 5,930 | 417 | 74 |
| 3 | 427 | 1,300 | 1,080 | 2,800 | 609 | 1,300 | 1,060 | 398 | 456 | 5,280 | 346 | 70 |
| 4 | 407 | 1,200 | 1,020 | 2,920 | 609 | 1,230 | 991 | 389 | 3,140 | 4,650 | 297 | 61 |
| 5 | 387 | 1,080 | 962 | | 585 | 1,170 | 959 | 3,090 | 3,490 | 3,840 | 235 | 57 |
| 6 | 368 | 904 | 875 | | 561 | 1,110 | 896 | 4,290 | 1,150 | 2,840 | 206 | 57 |
| 7 | 350 | 846 | 818 | | 538 | 1,020 | 806 | 1,710 | 642 | 2,150 | 265 | 53 |
| 8 | 314 | 763 | 763 | | 538 | 962 | 778 | 1,260 | 521 | 1,710 | 346 | 50 |
| 9 | 314 | 1,260 | 736 | | 492 | 875 | 722 | 2,590 | 499 | 1,360 | 329 | 46 |
| 10 | 297 | 1,920 | 786 | | 448 | 1,170 | 750 | 2,030 | 456 | 1,150 | 235 | 42 |
| 11 | 297 | | 763 | 1,500 | 427 | 1,680 | 695 | 1,180 | 398 | 927 | 192 | 39 |
| 12 | 297 | | 736 | | 448 | 1,680 | 642 | 991 | 363 | 778 | 165 | 38 |
| 13 | 297 | | 962 | | 515 | 1,440 | 616 | 835 | 313 | 642 | 165 | 42 |
| 14 | 280 | | 4,090 | | 763 | 1,500 | 544 | 722 | 297 | 567 | 142 | 42 |
| 15 | 280 | | 5,070 | | 1,260 | 1,720 | 544 | 668 | 281 | 521 | 136 | 39 |
| 16 | 263 | | 4,040 | | 1,170 | 4,190 | 521 | 616 | 265 | 477 | 136 | 39 |
| 17 | 263 | 1,200 | 3,080 | | 1,080 | 5,630 | 499 | 865 | 346 | 436 | 153 | 38 |
| 18 | 246 | | 2,560 | 846 | 1,020 | 9,030 | 477 | 591 | 281 | 398 | 136 | 37 |
| 19 | 246 | | 2,280 | 846 | 1,020 | 11,000 | 456 | 499 | 297 | 363 | 114 | 42 |
| 20 | 229 | | 2,400 | 818 | 1,050 | 8,880 | 456 | 499 | 1,180 | 329 | 109 | 38 |
| 21 | 229 | | 4,770 | 790 | 1,140 | 7,100 | 436 | 668 | 778 | 313 | 109 | 66 |
| 22 | 229 | | 5,770 | 790 | 1,470 | 6,090 | 417 | 806 | 1,220 | 297 | 94 | 835 |
| 23 | 229 | 634 | 7,210 | 846 | 2,120 | 5,420 | 398 | 1,220 | 4,410 | 281 | 89 | 567 |
| 24 | 297 | 609 | 7,210 | 904 | 2,440 | 4,770 | 398 | 1,180 | 5,560 | 250 | 99 | 250 |
| 25 | 350 | 585 | 6,560 | 875 | 2,040 | 4,090 | 398 | 1,400 | 8,320 | 235 | 94 | 178 |
| 26 | 585 | 585 | 6,270 | 818 | 1,720 | 3,290 | 380 | 991 | 8,060 | 220 | 94 | 136 |
| 27 | 736 | 585 | 5,560 | 790 | 1,640 | 2,640 | 363 | 1,680 | 8,600 | 178 | 84 | 104 |
| 28 | 1,680 | 684 | 4,730 | 763 | 1,540 | 2,190 | 346 | 1,680 | 7,560 | 165 | 79 | 89 |
| 29 | 1,680 | 933 | 3,940 | 710 | ..... | 1,830 | 363 | 1,090 | 6,770 | 165 | 79 | 79 |
| 30 | 1,720 | 1,440 | 3,340 | 684 | ..... | 1,640 | 380 | 896 | 6,660 | 192 | 70 | 70 |
| 31 | 1,750 | ..... | 2,960 | 684 | ..... | 1,400 | ..... | 778 | ..... | 250 | 89 | ..... |

*Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919-20. | | | | | | | | | | | | |
| 1 | 64 | 8,880 | 6,090 | 363 | 1,540 | 544 | 3,040 | 1,500 | 3,390 | 222 | 96 | 144 |
| 2 | 57 | 9,180 | 5,770 | 313 | 1,500 | 499 | 2,680 | 5,490 | 6,010 | 249 | 84 | 108 |
| 3 | 61 | 8,600 | 3,740 | 281 | 2,470 | 668 | 2,440 | 5,420 | 5,770 | 231 | 84 | 78 |
| 4 | 79 | 7,100 | 2,430 | 281 | 2,390 | 1,990 | 2,600 | 5,070 | 2,360 | 213 | 84 | 84 |
| 5 | 94 | 6,270 | 2,530 | 281 | 1,570 | 3,140 | 3,120 | 2,000 | 1,640 | 287 | 84 | 72 |
| 6 | 46 | 5,700 | 2,640 | 281 | 1,360 | 1,870 | 2,720 | 1,540 | 1,220 | 231 | 84 | 62 |
| 7 | 46 | 4,710 | 2,740 | 281 | 1,150 | 1,180 | 2,360 | 1,300 | 1,100 | 327 | 78 | 78 |
| 8 | 42 | 5,350 | 2,230 | 281 | 959 | 1,150 | 2,280 | 1,070 | 1,010 | 327 | 114 | 102 |
| 9 | 39 | 4,290 | 1,830 | 281 | 1,060 | 806 | 1,960 | 1,010 | 890 | 307 | 132 | 158 |
| 10 | 50 | 4,650 | 1,400 | 281 | 1,570 | 1,220 | 2,040 | 890 | 830 | 287 | 126 | 165 |
| 11 | 61 | 5,420 | 1,360 | 281 | 1,750 | 4,140 | 2,040 | 830 | 770 | 249 | 114 | 435 |
| 12 | 57 | 5,210 | 1,130 | 281 | 1,220 | 6,010 | 2,640 | 2,240 | 685 | 249 | 114 | 770 |
| 13 | 57 | 5,070 | 1,060 | 297 | 927 | 7,930 | 3,080 | 4,000 | 630 | 213 | 120 | 458 |
| 14 | 57 | 3,490 | 991 | 297 | 835 | 8,190 | 2,480 | 5,350 | 577 | 196 | 577 | 213 |
| 15 | 57 | 2,150 | 835 | 281 | 642 | 6,360 | 2,080 | 5,350 | 528 | 391 | 1,220 | 144 |
| 16 | 57 | 1,830 | 835 | 281 | 297 | 5,560 | 1,960 | 5,280 | 504 | 327 | 5,420 | 391 |
| 17 | 50 | 1,680 | 806 | 281 | 398 | 5,490 | 1,820 | 6,660 | 458 | 307 | 1,640 | 249 |
| 18 | 46 | 1,500 | 778 | 281 | 477 | 5,280 | 1,750 | 10,500 | 435 | 231 | 504 | 151 |
| 19 | 46 | 1,320 | 695 | 281 | 456 | 5,070 | 1,780 | 12,200 | 391 | 685 | 369 | 114 |
| 20 | 46 | 1,180 | 616 | 281 | 991 | 5,560 | 3,340 | 9,180 | 369 | 391 | 287 | 108 |
| 21 | 46 | 1,020 | 567 | 250 | 4,590 | 5,350 | 4,590 | 7,930 | 348 | 268 | 1,100 | 102 |
| 22 | 42 | 959 | 499 | 265 | 6,560 | 3,990 | 4,240 | 7,320 | 327 | 213 | 528 | 102 |
| 23 | 39 | 835 | 499 | 281 | 7,930 | 3,240 | 3,490 | 6,270 | 348 | 188 | 391 | 84 |
| 24 | 38 | 750 | 456 | 281 | 5,140 | 2,760 | 3,290 | 5,560 | 348 | 172 | 180 | 84 |
| 25 | 36 | 695 | 436 | 281 | 2,190 | 3,890 | 3,240 | 5,210 | 348 | 158 | 158 | 78 |
| 26 | 50 | 668 | 417 | 281 | 1,150 | 7,210 | 3,240 | 6,090 | 307 | 144 | 144 | 78 |
| 27 | 1,290 | 642 | 417 | 281 | 927 | 9,180 | 3,080 | 5,420 | 287 | 138 | 126 | 78 |
| 28 | 4,710 | 591 | 417 | 281 | 750 | 8,320 | 2,640 | 2,960 | 268 | 126 | 114 | 120 |
| 29 | 6,270 | 1,830 | 417 | 313 | 616 | 6,560 | 2,120 | 2,480 | 204 | 114 | 126 | 196 |
| 30 | 7,440 | 4,710 | 380 | 456 | ..... | 5,350 | 1,780 | 1,720 | 231 | 108 | 165 | 108 |
| 31 | 7,930 | ..... | 380 | 1,220 | ..... | 3,640 | ..... | 1,610 | ..... | 96 | 165 | ..... |

NOTE.—Gage not read, discharge estimated, Nov. 11–22, 1918. Gage not read, discharge interpolated, Nov. 18, and Dec. 5, 6, 1919. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kaskaskia River at Vandalia, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 1,980 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918-19. | | | | | |
| October | 1,750 | 229 | 515 | 0.260 | 0.30 |
| November | ..... | 585 | 1,090 | .551 | .61 |
| December | 7,210 | 736 | 3,020 | 1.53 | 1.76 |
| January | 3,840 | 684 | 1,400 | .707 | .82 |
| February | 2,440 | 427 | 1,020 | .515 | .54 |
| March | 11,000 | 875 | 3,190 | 1.61 | 1.86 |
| April | 1,260 | 346 | 623 | .315 | .35 |
| May | 4,290 | 380 | 1,170 | .591 | .68 |
| June | 8,600 | 265 | 2,450 | 1.24 | 1.38 |
| July | 6,460 | 165 | 1,400 | .707 | .82 |
| August | 417 | 70 | 178 | .090 | .10 |
| September | 835 | 37 | 113 | .057 | .06 |
| The year | 11,000 | 37 | 1,350 | .682 | 9.28 |
| 1919-20. | | | | | |
| October | 7,930 | 36 | 936 | .472 | .54 |
| November | 9,180 | 591 | 3,540 | 1.79 | 2.00 |
| December | 6,090 | 380 | 1,460 | .737 | .85 |
| January | 1,220 | 250 | 321 | .162 | .19 |
| February | 7,930 | 297 | 1,840 | .929 | 1.02 |
| March | 9,180 | 499 | 4,260 | 2.15 | 2.48 |
| April | 4,590 | 1,750 | 2,660 | 1.34 | 1.49 |
| May | 12,200 | 830 | 4,500 | 2.27 | 2.62 |
| June | 6,010 | 204 | 1,090 | .550 | .61 |
| July | 685 | 96 | 247 | .125 | .14 |
| August | 5,420 | 78 | 469 | .237 | .27 |
| September | 770 | 62 | 170 | .086 | .10 |
| The year | 12,200 | 36 | 1,790 | .904 | 12.31 |

### KASKASKIA RIVER AT NEW ATHENS, ILL.

LOCATION.—In W. ½ NE. ¼ sec. 28, T. 2 S., R. 7 W. third principal meridian, at Illinois Central Railroad bridge 600 feet north of railroad station at New Athens, St. Clair County, 1 mile below mouth of Silver Creek, and 3 miles above mouth of Lively Creek.

DRAINAGE AREA.—5,220 square miles.

RECORDS AVAILABLE.—January 23, 1907, to December 31, 1912; June 22, 1914, to September 30, 1920. Gage height of river was taken on Wednesday and Thursday mornings from January 23, 1907, to October 28, 1909, by C. J. von Roth Roffy for the New Athens Journal, in which they are published. These heights have been reduced to the present datum; maximum error probably not more than 0.4 foot, decreasing with increase of stage. Record is authentic.

GAGE.—Chain gage attached to bridge, installed November 1, 1909; read by Henry Hoffman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached or from highway bridge about 500 feet downstream.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 24.0 feet at noon June 10 (stage-discharge relation affected by backwater from Mississippi River); maximum discharge, 12,700 second-feet March 25 and 26; minimum stage recorded, 2.85 feet September 16–20 (discharge, 162 second-feet).

Maximum stage recorded during year ending September 30, 1920, 27.6 feet at noon November 1 (discharge, 28,000 second-feet); minimum stage, 2.89 feet October 23 (discharge, 172 second-feet).

1907–1912; 1914–1920: Maximum stage recorded, 35.7 feet August 26, 1915 (discharge, 63,100 second-feet); minimum stage, 2.08 feet August 10, 1914 (discharge, 102 second-feet).

ACCURACY.—Stage-discharge relation changed during high water of November, 1919, and again during high water of March, 1920; not seriously affected by ice during winter; affected by backwater from Mississippi River at various times. Three poorly defined rating curves used, applicable respectively, October 1, 1918, to November 17, 1919, November 18, 1919, to March 15, 1920, and March 16 to September 30, 1920. Indirect method for shifting control used November 2–17, 1919, and March 16–29, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records poor.

*Discharge measurements of Kaskaskia River at New Athens, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 22 | H. C. Beckman | 7.37 | 1,460 | Sept. 18 | H. C. Beckman | 2.85 | 160 |
| 1919. | | | | Nov. 20 | H. J. Dean | 21.15 | 9,730 |
| Mar. 13 | do | 11.86 | 3,720 | 1920. | | | |
| May 19 | do | 8.52 | 1,600 | Apr. 9 | do | [a]20.16 | 9,080 |
| Aug. 15 | do | 3.80 | 386 | | | | |

[a] Stage-discharge relation affected by backwater from Mississippi River.

*Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 916 | 2,150 | 3,550 | 8,600 | 1,240 | 3,150 | 8,700 | | | | 585 | 666 |
| 2 | 832 | 2,350 | 3,490 | 8,500 | 1,180 | 2,600 | 4,210 | | | | 505 | 401 |
| 3 | 776 | 2,100 | 2,750 | 8,400 | 1,120 | 2,350 | 3,430 | | | | 453 | 288 |
| 4 | 748 | 1,850 | 2,050 | 8,400 | 1,090 | 2,150 | 2,650 | | | | 531 | 250 |
| 5 | 693 | 1,600 | 1,650 | 8,310 | 1,030 | 2,050 | 2,300 | | | | 612 | 238 |
| | | | | | | | | 2,600 | 5,600 | 8,400 | | |
| 6 | 666 | 1,480 | 1,480 | 7,950 | 1,000 | 1,950 | 2,100 | | | | 558 | 250 |
| 7 | 612 | 1,360 | 1,400 | 6,070 | 972 | 1,850 | 2,000 | | | | 505 | 238 |
| 8 | 585 | 1,280 | 1,240 | 3,910 | 916 | 1,750 | 1,850 | | | | 505 | 225 |
| 9 | 558 | 1,850 | 1,180 | 2,950 | 916 | 1,650 | 1,700 | | | | 453 | 200 |
| 10 | 531 | 1,900 | 1,120 | 2,550 | 888 | 2,050 | 1,560 | | | | 453 | 200 |
| 11 | 505 | 2,600 | 1,060 | 2,400 | 832 | 2,650 | 1,400 | | | | 427 | 200 |
| 12 | 479 | 3,200 | 1,060 | 2,350 | 832 | 3,310 | 1,360 | | | | 479 | 188 |
| 13 | 479 | 2,900 | 2,450 | 2,150 | 832 | 3,790 | 1,320 | | | | 505 | 188 |
| 14 | 453 | 2,300 | 7,160 | 2,050 | 776 | 3,550 | | | | | 453 | 175 |
| 15 | 453 | 1,850 | 9,010 | 1,950 | 832 | 3,050 | | | | | 401 | 162 |
| | | | | | | | | 2,300 | 3,100 | 2,400 | | |
| 16 | 427 | 1,600 | 9,340 | 1,900 | 1,200 | 4,210 | | | | | 401 | 162 |
| 17 | 427 | 1,480 | 9,230 | 1,750 | 1,560 | 7,410 | 1,100 | | | | 479 | 162 |
| 18 | 401 | 1,440 | 9,340 | 1,700 | 2,450 | 9,230 | | | | | 427 | 162 |
| 19 | 401 | 1,480 | 9,580 | 1,600 | 2,350 | 10,100 | | | | | 350 | 162 |
| 20 | 401 | 1,750 | 9,580 | 1,520 | 1,950 | 10,800 | | | | | 401 | 162 |
| 21 | 375 | 1,600 | 9,580 | 1,480 | 1,850 | 11,300 | | | | 860 | 639 | 168 |
| 22 | 375 | 1,440 | 9,580 | 1,400 | 2,450 | 11,800 | | | | 832 | 720 | 175 |
| 23 | 375 | 1,310 | 9,340 | 1,400 | 4,090 | 12,100 | | | | 776 | 479 | 375 |
| 24 | 401 | 1,180 | 9,340 | 2,200 | 5,370 | 12,600 | | | | 720 | 375 | 720 |
| 25 | 453 | 1,090 | 9,580 | 2,900 | 5,860 | 12,700 | | | | 666 | 350 | 1,000 |
| | | | | | | | 860 | 3,300 | 6,500 | | | |
| 26 | 505 | 1,000 | 9,820 | 3,310 | 6,380 | 12,700 | | | | 639 | 325 | 944 |
| 27 | 639 | 944 | 9,700 | 2,850 | 5,860 | 12,600 | | | | 585 | 325 | 776 |
| 28 | 1,030 | 1,210 | 9,580 | 2,150 | 4,330 | 12,100 | | | | 558 | 300 | 558 |
| 29 | 1,560 | 1,480 | 9,340 | 1,750 | ..... | 11,500 | | | | 531 | 639 | 453 |
| 30 | 1,750 | 2,050 | 9,010 | 1,480 | ..... | 10,800 | | | | 531 | 832 | 2,350 |
| 31 | 1,950 | ..... | 8,700 | 1,360 | ..... | 9,940 | ..... | | ..... | 693 | 916 | ..... |
| 1919-20. | | | | | | | | | | | | |
| 1 | 2,350 | 28,000 | 7,020 | 935 | 4,070 | 6,540 | | | 9,760 | 575 | 260 | 1,920 |
| 2 | 1,060 | 27,400 | 7,180 | 960 | 4,760 | 4,700 | | | 10,400 | | 250 | 1,130 |
| 3 | 505 | 25,600 | 7,420 | 960 | 5,740 | 2,750 | | | 10,000 | | 230 | 1,010 |
| 4 | 666 | 25,000 | 7,500 | 985 | 6,380 | 2,900 | | | 9,200 | | 220 | 830 |
| 5 | 325 | 23,500 | 7,500 | 960 | 6,780 | 3,060 | | | 8,800 | 680 | 220 | 625 |
| | | | | | | | 10,300 | | | | | |
| 6 | 300 | 21,400 | 7,500 | 835 | 7,020 | 4,580 | | | 8,600 | | 210 | 475 |
| 7 | 325 | 22,300 | 8,300 | 785 | 6,700 | 5,740 | | | 8,600 | | 200 | 400 |
| 8 | 288 | 24,400 | 8,610 | 940 | 5,740 | 6,300 | | 4,000 | 8,200 | | 260 | 375 |
| 9 | 250 | 20,500 | 9,050 | 1,090 | 4,580 | 5,880 | | | 7,450 | 1,700 | 220 | 1,600 |
| 10 | 275 | 19,600 | 9,380 | 1,240 | 4,020 | 4,270 | | | 3,660 | | 220 | 3,560 |
| 11 | 225 | 19,300 | 9,160 | 1,040 | 3,770 | 4,700 | | | 2,320 | | 500 | 4,220 |
| 12 | 212 | 18,400 | 8,940 | 885 | 4,220 | 7,900 | | | 1,780 | | 500 | 3,830 |
| 13 | 212 | 17,500 | 8,300 | 835 | 4,420 | 9,160 | | | 1,520 | | 375 | 5,200 |
| 14 | 212 | 17,800 | 6,540 | 785 | 3,670 | 9,840 | | | 1,320 | | 325 | 5,780 |
| 15 | 200 | 15,300 | 3,520 | 735 | 2,980 | 10,700 | | | 1,220 | | 300 | 5,920 |
| 16 | 188 | 14,800 | 2,440 | 735 | 2,080 | 11,100 | | | 1,130 | | 500 | 4,600 |
| 17 | 200 | 13,700 | 1,850 | 710 | 1,490 | 11,400 | | | 1,040 | | 1,070 | 3,000 |
| 18 | 200 | 11,900 | 1,730 | 1,120 | 1,340 | 11,600 | | | 950 | 550 | 2,140 | 1,820 |
| 19 | 188 | 10,700 | 1,450 | 1,530 | 1,570 | 12,000 | | | 860 | | 4,050 | 1,480 |
| 20 | 175 | 9,840 | 1,270 | 1,610 | 1,450 | 12,300 | | | 800 | | 4,320 | 1,160 |
| | | | | | | | 6,700 | | | | | |
| 21 | 188 | 8,720 | 1,260 | 2,300 | 2,440 | 12,200 | | | 750 | | 3,350 | 700 |
| 22 | 175 | 6,020 | 1,240 | 2,660 | 4,640 | 11,900 | | | 700 | | 2,050 | 575 |
| 23 | 175 | 3,290 | 1,200 | 3,160 | 5,880 | 11,500 | | 12,000 | 675 | | 1,250 | 500 |
| 24 | 175 | 2,390 | 1,160 | 3,820 | 6,780 | 11,100 | | | 650 | | 1,440 | 425 |
| 25 | 190 | 1,980 | 1,070 | 4,120 | 7,340 | 11,900 | | | 650 | | 1,400 | 400 |
| 26 | 200 | 1,770 | 1,040 | 3,470 | 7,900 | 12,600 | | | 650 | 425 | 1,070 | 350 |
| 27 | 3,200 | 1,650 | 985 | 3,110 | 7,800 | 13,400 | | | 650 | 375 | 800 | 425 |
| 28 | 9,100 | 1,530 | 985 | 2,880 | 7,600 | 14,200 | | | 650 | 325 | 625 | 375 |
| 29 | 25,300 | 2,030 | 985 | 2,520 | 7,180 | 14,200 | | | 625 | 300 | 650 | 375 |
| 30 | 26,800 | 5,810 | 985 | 2,700 | ..... | 13,900 | | | 575 | 280 | 920 | 375 |
| 31 | 27,400 | ..... | 960 | 3,570 | ..... | 13,400 | ..... | | ..... | 280 | 860 | ..... |

NOTE.—Discharge estimated, owing to lack of gage readings, by comparison with flow at Vandalia, Oct. 30 to Nov. 3, 1918, and Oct. 24–28, 1919. Discharge interpolated on account of lack of gage readings, Nov. 23, 28, 1918, Feb. 16, Sept. 21, Dec. 21, 1919, Jan. 8, 9, 18, Mar. 4, and Sept. 29, 1920. Stage-discharge relation affected by backwater from Mississippi River, Apr. 14 to July 20, 1919, Mar. 30 to May 31, 1920, and July 2–25, 1920; discharge ascertained by means of two discharge measurements, gage heights of Mississippi River at Chester, Ill., and a study of the flow at Vandalia. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kaskaskia River at New Athens, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 5,220 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 1,950 | 375 | 670 | 0.128 | 0.15 |
| November | 3,200 | 944 | 1,730 | .331 | .37 |
| December | 9,820 | 1,060 | 6,170 | 1.18 | 1.36 |
| January | 8,600 | 1,360 | 3,460 | .663 | .76 |
| February | 6,380 | 776 | 2,150 | .412 | .43 |
| March | 12,700 | 1,650 | 6,770 | 1.30 | 1.50 |
| April | 8,700 | ..... | 1,700 | .326 | .36 |
| May | ..... | ..... | 2,650 | .508 | .59 |
| June | ..... | ..... | 5,070 | .971 | 1.08 |
| July | ..... | 531 | 3,720 | .713 | .82 |
| August | 916 | 300 | 496 | .095 | .11 |
| September | 2,350 | 162 | 407 | .078 | .09 |
| The year | 12,700 | 162 | 2,930 | .561 | 7.62 |
| 1919–20. | | | | | |
| October | 27,400 | 175 | 3,270 | .626 | .72 |
| November | 28,000 | 1,530 | 14,100 | 2.70 | 3.01 |
| December | 9,380 | 960 | 4,400 | .843 | .97 |
| January | 4,120 | 710 | 1,740 | .333 | .38 |
| February | 7,900 | 1,340 | 4,840 | .927 | 1.00 |
| March | 14,200 | 2,750 | 9,280 | 1.78 | 2.05 |
| April | ..... | ..... | 7,900 | 1.51 | 1.68 |
| May | ..... | ..... | 8,130 | 1.56 | 1.80 |
| June | 10,400 | 575 | 3,470 | .665 | .74 |
| July | ..... | 289 | 645 | .124 | .14 |
| August | 4,320 | 200 | 993 | .190 | .22 |
| September | 5,920 | 350 | 1,780 | .341 | .38 |
| The year | 28,000 | 175 | 5,030 | .964 | 13.09 |

### BIG MUDDY RIVER AT PLUMFIELD, ILL.

LOCATION.—In W. ½ sec. 20, T. 7 S., R. 2 E., at highway bridge in Plumfield, Franklin County, 6 miles west of West Frankfort, 1½ miles below mouth of Middle Fork, and 2 miles below station formerly maintained at Chicago, Burlington & Quincy Railroad bridge.

DRAINAGE AREA.—753 square miles.

RECORDS AVAILABLE.—August 18, 1914, to September 30, 1920. From June 16, 1908, to December 31, 1912, records were obtained at Chicago, Burlington & Quincy Railroad bridge, 2 miles upstream.

GAGE.—Chain gage attached to bridge; read by Louis Robertson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Control is about a quarter of a mile below gage; somewhat shifting. Point of zero flow is at a stage of about 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 20.84 feet December 17 (discharge, 6,050 second-feet); minimum discharge, 1.0 second-foot August 5–8.

Maximum stage recorded during year ending September 30, 1920, 24.24 feet October 31 and November 3 (discharge, 9,270 second-feet); minimum discharge, 1.0 second-foot October 1–4 and 6–8.

1914–1920: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum discharge, no flow, August 18–26, 1914.

ACCURACY.—Stage-discharge relation changed during high water of December, 1918, and again during March, 1920; not affected by ice. Rating curve used October 1, 1918, to March 20, 1920, poorly defined below 250 second-feet, and fairly well defined above that point; curve used March 21 to September 30, 1920, fairly well defined throughout. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for days when gage was not read for which it was ascertained by interpolation. Records fair.

*Discharge measurements of Big Muddy River at Plumfield, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1919. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Mar. 14 | H. C. Beckman | 5.88 | 418 | Nov. 21 | H. J. Dean | 3.66 | [a] 132 |
| Aug. 15 | do | .89 | 1.6 | | | | |
| 15 | do | .89 | 1.8 | 1920. | | | |
| | | | | Apr. 7 | do | 8.96 | 975 |

[a] Discharge corrected for falling stage=158 sec.-ft.

*Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | | | | |
| 1 | 9 | 41 | 426 | 590 | 117 | 470 | 117 | 1,730 | 1,670 | 2,400 | 2 | 117 |
| 2 | 6 | 32 | 205 | 1,010 | 97 | 185 | 86 | 2,000 | 2,180 | 1,610 | 2 | 54 |
| 3 | 6 | 28 | 145 | 1,180 | 82 | 155 | 73 | 2,400 | 2,680 | 730 | 2 | 36 |
| 4 | 5 | 22 | 82 | 734 | 73 | 135 | 64 | 2,360 | 1,460 | 175 | 2 | 17 |
| 5 | 4 | 19 | 64 | 622 | 67 | 109 | 61 | 2,640 | 1,460 | 61 | 1 | 11 |
| 6 | 3 | 18 | 56 | 395 | 58 | 101 | 58 | 2,360 | 1,340 | 44 | 1 | 7 |
| 7 | 3 | 16 | 46 | 165 | 56 | 101 | 54 | 2,090 | 1,300 | 31 | 1 | 5 |
| 8 | 3 | 15 | 36 | 109 | 51 | 117 | 51 | 1,700 | 1,320 | 28 | 1 | 4 |
| 9 | 3 | 33 | 34 | 82 | 46 | 654 | 48 | 1,700 | 1,2 0 | 17 | 3 | 4 |
| 10 | 2 | 41 | 33 | 73 | 44 | 974 | 41 | 1,910 | 760 | 13 | 2 | 3 |
| 11 | 2 | 82 | 36 | 64 | 41 | 1,120 | 48 | 2,150 | 293 | 13 | 2 | 3 |
| 12 | 3 | 90 | 570 | 58 | 36 | 1,060 | 54 | 2,320 | 175 | 15 | 2 | 2 |
| 13 | 3 | 61 | 1,100 | 58 | 38 | 638 | 46 | 2,320 | 90 | 13 | 4 | 2 |
| 14 | 3 | 44 | 2,120 | 64 | 100 | 357 | 35 | 1,820 | 58 | 8 | 2 | 2 |
| 15 | 3 | 34 | 3,550 | 70 | 162 | 344 | 48 | 852 | 44 | 7 | 2 | 2 |
| 16 | 3 | 33 | 5,200 | 73 | 225 | 1,140 | 331 | 318 | 34 | 5 | 2 | 2 |
| 17 | 3 | 56 | 6,020 | 67 | 281 | 2,320 | 205 | 205 | 245 | 4 | 2 | 2 |
| 18 | 2 | 360 | 5,840 | 67 | 235 | 4,390 | 93 | 135 | 318 | 4 | 24 | 2 |
| 19 | 3 | 670 | 5,010 | 67 | 145 | 5,680 | 67 | 145 | 384 | 3 | 46 | 2 |
| 20 | 3 | 398 | 4,180 | 67 | 135 | 5,840 | 51 | 670 | 357 | 3 | 38 | 2 |
| 21 | 3 | 175 | 3,730 | 70 | 565 | 5,120 | 44 | 852 | 767 | 3 | 26 | 7 |
| 22 | 3 | 93 | 3,170 | 70 | 992 | 4,0'0 | 38 | 903 | 702 | 3 | 17 | 5 |
| 23 | 15 | 64 | 3,510 | 622 | 1,3'0 | 2,970 | 67 | 1,140 | 638 | 3 | 12 | 41 |
| 24 | 21 | 51 | 3,850 | 1,200 | 1,500 | 2,0'0 | 76 | 1,610 | 938 | 3 | 9 | 11 |
| 25 | 34 | 41 | 4,110 | 1,420 | 1,580 | 1,120 | 79 | 1,760 | 1,100 | 3 | 7 | 5 |
| 26 | 44 | 32 | 3,910 | 1,540 | 1,540 | 606 | 58 | 2,000 | 1,790 | 3 | 5 | 2 |
| 27 | 36 | 26 | 3,430 | 1,460 | 1,400 | 686 | 51 | 2,180 | 2,440 | 2 | 4 | 3 |
| 28 | 41 | 76 | 2,720 | 920 | 750 | 750 | 48 | 2,280 | 3,170 | 2 | 4 | 2 |
| 29 | 41 | 530 | 1,940 | 370 | ..... | 500 | 357 | 2,400 | 3,170 | 3 | 5 | 2 |
| 30 | 165 | 670 | 1,200 | 215 | ..... | 332 | 1,300 | 2,280 | 2,870 | 2 | 215 | 2 |
| 31 | 135 | ..... | 900 | 155 | ..... | 165 | ..... | 2,090 | ..... | 2 | 165 | ..... |

*Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1919 and 1920*—Continued.

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1919–20. | | | | | | | | | | | | |
| 1 | 1 | 9,230 | 2,400 | 51 | 1,010 | 79 | 1,490 | 80 | 625 | 4 | 7 | 4 |
| 2 | 1 | 9,230 | 2,920 | 51 | 835 | 67 | 873 | 67 | 1,210 | 4 | 6 | 78 |
| 3 | 1 | 9,230 | 3,850 | 51 | 852 | 61 | 655 | 76 | 2,120 | 4 | 4 | 153 |
| 4 | 1 | 9,130 | 4,010 | 38 | 1,060 | 590 | 380 | 625 | 3,790 | 258 | 4 | 133 |
| 5 | 2 | 8,730 | 3,550 | 41 | 1,220 | 1,260 | 338 | 685 | 4,530 | 153 | 4 | 80 |
| 6 | 1 | 8,030 | 3,070 | 79 | 1,260 | 1,480 | 825 | 310 | 3,950 | 72 | 3 | 50 |
| 7 | 1 | 6,470 | 2,720 | 160 | 1,180 | 1,610 | 985 | 284 | 3,370 | 41 | 4 | 31 |
| 8 | 1 | 6,560 | 2,640 | 240 | 1,040 | 1,700 | 809 | 464 | 2,440 | 26 | 5 | 20 |
| 9 | 10 | 5,680 | 2,640 | 320 | 835 | 1,760 | 408 | 215 | 1,390 | 22 | 35 | 19 |
| 10 | 293 | 5,280 | 2,600 | 398 | 654 | 1,540 | 209 | 180 | 625 | 17 | 65 | 145 |
| 11 | 426 | 4,740 | 2,440 | 357 | 560 | 1,220 | 153 | 113 | 345 | 13 | 94 | 271 |
| 12 | 606 | 4,390 | 2,030 | 235 | 500 | 2,400 | 209 | 460 | 62 | 11 | 62 | 436 |
| 13 | 702 | 4,180 | 1,360 | 245 | 370 | 3,970 | 841 | 809 | 43 | 9 | 72 | 233 |
| 14 | 560 | 3,970 | 165 | 426 | 269 | 5,360 | 1,050 | 1,190 | 32 | 10 | 67 | 610 |
| 15 | 225 | 3,670 | 175 | 580 | 205 | 5,520 | 1,150 | 1,150 | 26 | 10 | 43 | 761 |
| 16 | 117 | 3,170 | 175 | 734 | 145 | 5,120 | 1,080 | 1,000 | 20 | 7 | 30 | 921 |
| 17 | 76 | 2,520 | 130 | 1,030 | 135 | 4,670 | 580 | 1,820 | 15 | 6 | 21 | 953 |
| 18 | 56 | 1,670 | 86 | 1,180 | 86 | 4,460 | 297 | 2,240 | 12 | 5 | 13 | 730 |
| 19 | 36 | 992 | 76 | 1,260 | 70 | 4,600 | 366 | 3,320 | 9 | 670 | 103 | 245 |
| 20 | 24 | 440 | 61 | 1,160 | 64 | 4,600 | 921 | 5,680 | 7 | 492 | 85 | 94 |
| 21 | 56 | 135 | 54 | 1,140 | 82 | 4,670 | 1,210 | 7,190 | 7 | 300 | 54 | 54 |
| 22 | 470 | 86 | 41 | 1,200 | 257 | 4,460 | 1,390 | 7,610 | 6 | 108 | 35 | 33 |
| 23 | 515 | 70 | 38 | 1,420 | 835 | 3,850 | 1,650 | 7,830 | 5 | 72 | 20 | 22 |
| 24 | 235 | 61 | 38 | 1,850 | 974 | 3,070 | 1,880 | 7,460 | 5 | 38 | 15 | 15 |
| 25 | 93 | 56 | 41 | 2,050 | 835 | 2,280 | 1,820 | 6,740 | 5 | 25 | 10 | 12 |
| 26 | 165 | 90 | 41 | 2,210 | 455 | 2,060 | 1,370 | 5,600 | 5 | 28 | 7 | 10 |
| 27 | 1,420 | 318 | 41 | 2,610 | 205 | 2,120 | 580 | 4,390 | 4 | 46 | 5 | 41 |
| 28 | 1,760 | 357 | 38 | 2,600 | 135 | 2,560 | 186 | 3,170 | 4 | 39 | 5 | 42 |
| 29 | 5,520 | 1,180 | 38 | 2,320 | 101 | 3,320 | 123 | 1,800 | 4 | 26 | 4 | 17 |
| 30 | 8,930 | 1,880 | 46 | 1,940 | ..... | 3,020 | 98 | 1,410 | 4 | 16 | 4 | 17 |
| 31 | 9,230 | ..... | 48 | 1,970 | ..... | 2,360 | ..... | 953 | ..... | 10 | 5 | ..... |

NOTE.—Discharge interpolated on account of lack of gage readings, Oct. 25, Nov. 18, Dec. 12, 23, 31, 1918, Jan. 6, 28, Feb. 14, 15, 21, Mar. 1, 22, 24, 30, June 2, 10, Aug. 18, 31, Dec. 1, 17, 1919, Jan. 7–9, 15, 25, May 10, 12, June 6, 11, July 21, Aug. 9, 10, and Sept. 2, 10, 1920.

*Monthly discharge of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 753 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 165 | 2 | 19.7 | 0.026 | 0.03 |
| November | 670 | 15 | 128 | .170 | .19 |
| December | 6,020 | 33 | 2,170 | 2.88 | 3.32 |
| January | 1,540 | 58 | 441 | .586 | .68 |
| February | 1,580 | 36 | 420 | .558 | .58 |
| March | 5,840 | 101 | 1,430 | 1.90 | 2.19 |
| April | 1,300 | 35 | 125 | .166 | .19 |
| May | 2,640 | 135 | 1,660 | 2.20 | 2.54 |
| June | 3,170 | 34 | 1,170 | 1.55 | 1.73 |
| July | 2,400 | 2 | 169 | .224 | .26 |
| August | 215 | 1 | 19.7 | .026 | .03 |
| September | 117 | 2 | 12.0 | .016 | .02 |
| The year | 6,020 | 1 | 651 | .865 | 11.76 |
| 1919–20. | | | | | |
| October | 9,230 | 1 | 1,020 | 1.35 | 1.56 |
| November | 9,230 | 56 | 3,720 | 4.93 | 5.51 |
| December | 4,040 | 38 | 1,210 | 1.61 | 1.86 |
| January | 2,640 | 38 | 968 | 1.29 | 1.49 |
| February | 1,260 | 64 | 560 | .744 | .80 |
| March | 5,520 | 61 | 2,770 | 3.68 | 4.24 |
| April | 1,880 | 98 | 798 | 1.06 | 1.18 |
| May | 7,830 | 67 | 2,420 | 3.21 | 3.70 |
| June | 4,530 | 4 | 822 | 1.09 | 1.22 |
| July | 670 | 4 | 82.0 | .109 | .13 |
| August | 103 | 3 | 28.7 | .038 | .04 |
| September | 953 | 4 | 208 | .276 | .31 |
| The year | 9,230 | 1 | 1,220 | 1.62 | 22.04 |

### BIG MUDDY RIVER AT MURPHYSBORO, ILL.

LOCATION.—In SW. ¼ sec. 8, T. 9 S., R. 2 W., at lower highway bridge on South Twentieth Street, Murphysboro, Jackson County, a quarter of a mile below mouth of Louis Creek.

DRAINAGE AREA.—2,170 square miles.

RECORDS AVAILABLE.—December 6, 1916, to September 30, 1920.

GAGE.—Chain gage attached to bridge; read by Clarence Jacobs.

CHANNEL AND CONTROL.—Bed composed of heavy clay; likely to shift.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 28.05 feet at 5 p. m. December 19 (discharge, 10,900 second-feet); minimum stage, 1.57 feet August 11–13 (discharge, 3.0 second-feet).

Maximum stage recorded during year ending September 30, 1920, 34.0 feet at 7 a. m. November 5 (discharge not determined because of backwater from Mississippi River); maximum stage recorded during periods of no backwater effect, 24.0 feet March 13 (discharge, 8,690 second-feet); minimum stage, 1.80 feet October 6 and 7 (discharge, 14 second-feet).

1917–1920: Maximum discharge recorded, 15,600 second-feet January 10, 1917; minimum stage recorded, 1.57 feet August 11–13, 1919 (discharge, 3.0 second-feet).

The highest known stage of this river occurred about February 2, 1916, when a height of 39.6 feet on the present gage was reached (discharge, from extension of rating curve, 28,000 second-feet).

ACCURACY.—Stage-discharge relation changed slightly during high water of June and July, 1920; affected by backwater from Mississippi River whenever height on United States Weather Bureau gage at Chester, Ill., is above about 10 feet; not affected by ice. One rating curve, fairly well defined between 5 and 12,000 second-feet, used; indirect method for shifting control used August 12 to September 30, 1920. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to tables of daily discharge. Records fair.

*Discharge measurements of Big Muddy River at Murphysboro, Ill., during the years ending Sept. 30, 1919 and 1920.*

| Date. | Made by— | Gage height. | Discharge. | Date. | Made by— | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| 1918. | | *Feet.* | *Sec.-ft.* | 1919. | | *Feet.* | *Sec.-ft.* |
| Nov. 19 | J. B. Fountain | 4.82 | 469 | Aug. 14 | H. C. Beckman | 1.69 | 4.2 |
| 20 | H. C. Beckman | 6.32 | 868 | Sept. 19 | do | 1.72 | 7.6 |
| 1919. | | | | 19 | do | 1.72 | 8.0 |
| Mar. 13 | do | 11.15 | 2,320 | 1920. | | | |
| Aug. 14 | do | 1.69 | 4.0 | Apr. 8 | H. J. Dean | [a] 16.90 | 1,730 |

[a] Stage-discharge relation affected by backwater from Mississippi River.

*Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1918–19.** | | | | | | | | | | | | |
| 1 | 2.40 | 3.48 | 7.95 | 13.70 | 5.70 | 11.28 | 10.80 | 12.40 | 17.78 | 20.22 | 1.93 | 6.25 |
| 2 | 2.32 | 3.38 | 7.90 | 12.60 | 4.90 | 9.43 | 9.90 | 15.30 | 15.13 | 19.13 | 2.23 | 7.80 |
| 3 | 2.20 | 3.18 | 6.60 | 11.70 | 4.45 | 6.83 | 9.20 | 15.50 | 16.43 | 17.98 | 2.07 | 5.80 |
| 4 | 1.98 | 2.96 | 5.35 | 10.10 | 3.95 | 4.93 | 8.50 | 16.10 | 16.48 | 16.08 | 2.05 | 4.10 |
| 5 | 1.60 | 2.78 | 4.35 | 9.60 | 3.85 | 4.83 | 7.80 | 17.10 | 17.78 | 13.08 | 1.98 | 3.36 |
| 6 | 1.98 | 2.68 | 3.75 | 8.75 | 3.70 | 4.43 | 7.40 | 18.55 | 17.98 | 9.28 | 1.85 | 3.00 |
| 7 | 1.80 | 2.60 | 3.45 | 7.50 | 3.55 | 4.28 | 7.35 | 18.55 | 18.93 | 6.68 | 1.83 | 2.70 |
| 8 | 1.74 | 2.50 | 3.32 | 5.80 | 3.30 | 4.13 | 7.20 | 17.65 | 20.68 | 5.48 | 1.77 | 2.45 |
| 9 | 1.78 | 2.78 | 3.10 | 4.80 | 3.30 | 5.48 | 7.10 | 19.20 | 20.78 | 5.18 | 1.67 | 2.30 |
| 10 | 1.74 | 2.76 | 3.06 | 4.20 | 3.10 | 8.83 | 7.00 | 20.90 | 19.68 | 4.98 | 1.61 | 2.20 |
| 11 | 1.72 | 2.72 | 3.00 | 3.75 | 3.08 | 11.00 | 6.80 | 21.10 | 18.68 | 5.93 | 1.57 | 2.10 |
| 12 | 2.50 | 2.82 | 2.96 | 3.60 | 3.08 | 12.00 | 6.55 | 21.40 | 15.08 | 6.93 | 1.57 | 2.00 |
| 13 | 1.80 | 2.78 | 8.40 | 3.60 | 3.18 | 11.56 | 6.55 | 20.50 | 14.28 | 8.48 | 1.57 | 1.90 |
| 14 | 1.78 | 2.84 | 19.40 | 3.55 | 3.38 | 10.48 | 8.30 | 19.80 | 12.64 | 7.98 | 1.67 | 1.80 |
| 15 | 1.76 | 2.88 | 22.84 | 3.70 | 3.58 | 9.10 | 11.10 | 19.10 | 12.48 | 5.98 | 1.66 | 1.78 |
| 16 | 1.78 | 3.18 | 25.00 | 3.70 | 4.08 | 9.85 | 13.10 | 18.00 | 11.30 | 4.88 | 2.58 | 1.74 |
| 17 | 1.74 | 2.84 | 26.65 | 3.70 | 4.63 | 19.25 | 13.10 | 16.80 | 11.06 | 4.38 | 2.70 | 1.72 |
| 18 | 1.62 | 3.98 | 27.85 | 3.70 | 5.38 | 22.40 | 12.72 | 14.10 | 11.52 | 4.13 | 3.40 | 1.66 |
| 19 | 1.70 | 4.48 | 28.05 | 3.70 | 5.48 | 25.00 | 11.10 | 11.90 | 10.90 | 4.08 | 2.92 | 1.60 |
| 20 | 1.74 | 5.90 | 27.40 | 3.70 | 5.18 | 26.65 | 11.10 | 11.56 | 10.42 | 3.68 | 2.90 | 1.68 |
| 21 | 1.72 | 7.00 | 26.65 | 3.70 | 5.33 | 27.55 | 11.14 | 12.40 | 11.44 | 3.27 | 2.90 | 1.90 |
| 22 | 1.70 | 6.40 | 26.20 | 3.70 | 7.38 | 27.30 | 10.90 | 12.90 | 11.48 | 2.97 | 3.75 | 3.80 |
| 23 | 2.40 | 5.20 | 25.70 | 5.65 | 11.26 | 26.40 | 11.10 | 14.25 | 11.78 | 2.67 | 4.40 | 4.10 |
| 24 | 2.80 | 4.20 | 25.20 | 8.60 | 14.13 | 25.30 | 11.32 | 14.50 | 12.18 | 2.57 | 3.50 | 4.40 |
| 25 | 3.30 | 3.60 | 24.20 | 12.20 | 14.78 | 23.85 | 11.20 | 15.30 | 12.52 | 2.27 | 3.10 | 3.90 |
| 26 | 4.00 | 3.30 | 23.45 | 13.10 | 13.98 | 21.95 | 10.84 | 16.10 | 16.28 | 2.13 | 3.06 | 3.10 |
| 27 | 3.98 | 3.10 | 22.40 | 12.50 | 13.08 | 19.55 | 10.60 | 16.80 | 15.88 | 2.07 | 3.18 | 2.80 |
| 28 | 3.88 | 3.60 | 21.10 | 12.00 | 12.38 | 17.15 | 10.60 | 21.32 | 16.88 | 2.07 | 3.00 | 2.70 |
| 29 | 3.78 | 4.40 | 19.60 | 11.28 | ..... | 14.95 | 10.75 | 21.54 | 18.68 | 2.07 | 3.32 | 2.65 |
| 30 | 3.63 | 7.05 | 17.80 | 9.80 | ..... | 13.16 | 11.80 | 21.74 | 20.18 | 1.97 | 2.70 | 2.60 |
| 31 | 3.58 | ..... | 15.75 | 7.50 | ..... | 11.80 | ..... | 20.45 | ..... | 1.93 | 4.90 | ..... |
| **1919–20.** | | | | | | | | | | | | |
| 1 | 2.40 | 30.80 | 21.30 | 3.45 | 16.68 | 4.67 | 23.52 | 15.00 | 22.32 | 6.70 | 4.00 | 2.70 |
| 2 | 2.20 | 32.10 | 22.40 | 3.40 | 14.88 | 4.37 | 22.41 | 15.10 | 20.00 | 5.50 | 3.75 | 3.50 |
| 3 | 2.10 | 33.00 | 23.60 | 3.45 | 13.78 | 4.07 | 20.77 | 15.20 | 17.30 | 4.35 | 3.45 | 3.50 |
| 4 | 1.90 | 33.70 | 24.15 | 3.40 | 12.88 | 4.17 | 19.57 | 15.45 | 17.20 | 10.14 | 3.14 | 3.30 |
| 5 | 1.85 | 34.00 | 23.80 | 3.45 | 12.70 | 4.47 | 17.57 | 15.65 | 18.40 | 10.52 | 2.90 | 3.40 |
| 6 | 1.80 | 33.80 | 23.02 | 3.45 | 12.80 | 5.17 | 16.07 | 15.85 | 18.50 | 10.50 | 2.80 | 3.20 |
| 7 | 1.80 | 32.86 | 22.28 | 3.85 | 12.50 | 5.97 | 17.22 | 18.00 | 19.05 | 10.30 | 2.70 | 3.30 |
| 8 | 1.90 | 32.35 | 22.60 | 4.15 | 12.08 | 6.87 | 17.07 | 17.55 | 19.00 | 9.60 | 2.40 | 3.12 |
| 9 | 2.40 | 31.80 | 22.30 | ..... | 11.84 | 8.07 | 16.80 | 15.70 | 18.50 | 9.80 | 3.70 | 3.08 |
| 10 | 5.60 | 32.35 | 21.24 | ..... | 11.54 | 12.12 | 16.80 | 14.35 | 17.40 | 9.70 | 4.10 | 2.92 |
| 11 | 8.70 | 31.62 | 19.65 | 5.35 | 10.50 | 14.07 | 17.10 | 12.60 | 15.40 | 9.70 | 5.15 | 4.80 |
| 12 | 11.00 | 31.06 | 18.25 | 7.45 | 9.68 | 18.37 | 17.05 | 11.10 | 12.20 | 9.45 | 4.95 | 3.70 |
| 13 | 12.14 | 30.44 | 16.15 | 9.00 | 8.78 | 23.97 | 17.05 | 11.68 | 9.80 | 8.50 | 4.35 | 3.45 |
| 14 | 12.20 | 29.70 | 15.10 | 9.50 | 7.78 | 23.57 | 17.66 | 12.60 | 8.40 | 8.40 | 3.80 | 3.80 |
| 15 | 11.20 | 28.65 | 13.10 | 8.95 | 6.78 | 24.62 | 17.75 | 14.80 | 7.80 | 7.50 | 3.32 | 4.10 |
| 16 | 9.40 | 26.40 | 9.65 | 8.20 | 6.48 | 25.07 | 17.70 | 14.90 | 7.80 | 8.40 | 4.35 | 5.35 |
| 17 | 8.00 | 25.30 | 6.50 | 8.80 | 5.28 | 29.67 | 17.50 | 20.10 | 7.40 | 8.50 | 4.15 | 6.10 |
| 18 | 7.85 | 23.30 | 5.34 | 9.25 | 5.18 | 29.82 | 16.80 | 23.16 | 6.80 | 9.20 | 4.05 | 6.36 |
| 19 | 6.20 | 21.14 | 4.90 | 9.45 | 5.08 | 29.77 | 16.35 | 24.30 | 5.70 | 9.80 | 3.85 | 7.35 |
| 20 | 5.40 | 18.50 | 4.35 | 10.35 | 5.13 | 29.87 | 16.30 | 27.40 | 4.80 | 10.00 | 3.32 | 6.10 |
| 21 | 5.00 | 15.30 | 4.10 | 12.20 | 5.48 | 29.77 | 16.30 | 29.45 | 4.75 | 10.10 | 3.22 | 6.85 |
| 22 | 8.35 | 12.25 | 3.85 | 13.45 | 6.33 | 29.67 | 17.50 | 30.80 | 4.50 | 9.75 | 3.22 | 7.10 |
| 23 | 8.05 | 7.80 | 3.70 | 15.70 | 7.73 | 29.62 | 19.65 | 32.24 | 4.50 | 8.75 | 3.30 | 6.90 |
| 24 | 7.35 | 5.35 | 3.65 | 15.92 | 8.83 | 29.47 | 19.65 | 33.10 | 5.00 | 8.30 | 3.12 | 5.40 |
| 25 | 6.80 | 5.15 | 3.50 | 20.74 | 10.22 | 27.87 | 19.90 | 33.10 | 5.90 | 8.70 | 2.98 | 4.70 |
| 26 | 7.90 | 5.10 | 3.45 | 20.92 | 9.33 | 26.57 | 19.65 | 32.50 | 5.95 | 9.30 | 2.64 | 3.80 |
| 27 | 11.90 | 7.35 | 3.45 | 21.10 | 8.38 | 25.37 | 18.65 | 31.60 | 6.00 | 9.70 | 2.68 | 3.70 |
| 28 | 14.85 | 8.85 | 3.50 | 20.90 | 7.18 | 20.07 | 17.50 | 30.58 | 6.50 | 7.40 | 2.50 | 3.40 |
| 29 | 18.00 | 13.90 | 3.50 | 20.40 | 6.08 | 25.52 | 16.15 | 29.30 | 6.55 | 5.60 | 2.40 | 2.95 |
| 30 | 22.10 | 20.30 | 3.45 | 20.00 | ..... | 25.42 | 15.50 | 27.30 | 6.80 | 4.70 | 2.64 | 2.90 |
| 31 | 24.80 | ..... | 3.50 | 18.60 | ..... | 24.42 | ..... | 25.50 | ..... | 4.50 | 2.50 | ..... |

*Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the years ending Sept. 30, 1919 and 1920.*

| Day. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1918-19. | | | | | | | | | |
| 1 | 58 | 208 | 1,356 | 3,280 | 689 | 2,340 | | 22 | 824 |
| 2 | 51 | 190 | 1,320 | 2,840 | 492 | 1,770 | | 43 | 1,290 |
| 3 | 41 | 156 | 936 | 2,480 | 381 | 992 | | 32 | 716 |
| 4 | 26 | 118 | 612 | 1,980 | 300 | 492 | | 30 | 320 |
| 5 | 4 | 100 | 381 | 1,830 | 262 | 469 | | 22 | 173 |
| 6 | 26 | 89 | 262 | 1,590 | 244 | 381 | | 17 | 125 |
| 7 | 14 | 78 | 199 | 1,290 | 219 | 369 | | 16 | 89 |
| 8 | 10 | 68 | 173 | 716 | 173 | 320 | | 12 | 63 |
| 9 | 13 | 100 | 140 | 469 | 173 | 637 | | 7 | 49 |
| 10 | 10 | 94 | 132 | 340 | 140 | 1,590 | | 4 | 41 |
| 11 | 9 | 89 | 125 | 262 | 140 | 2,250 | | 3 | 34 |
| 12 | 68 | 100 | 118 | 226 | 140 | 2,600 | | 3 | 27 |
| 13 | 14 | 100 | 1,470 | 226 | 156 | 2,440 | | 3 | 20 |
| 14 | 13 | 106 | 5,900 | 219 | 190 | 2,100 | | 7 | 14 |
| 15 | 12 | 112 | 7,680 | 244 | 226 | 1,680 | | 6 | 13 |
| 16 | 13 | 156 | 9,000 | 244 | 320 | 1,890 | | 78 | 10 |
| 17 | 10 | 106 | 9,960 | 244 | 424 | | | 89 | 9 |
| 18 | 5 | 300 | 10,800 | 244 | 612 | | | 190 | 6 |
| 19 | 8 | 472 | 10,900 | 244 | 637 | | | 112 | 4 |
| 20 | 10 | 743 | 10,500 | 244 | 563 | | | 112 | 7 |
| 21 | 9 | 1,050 | 9,960 | 244 | 587 | | | 112 | 20 |
| 22 | 8 | 880 | 9,720 | 244 | 1,170 | | | 262 | 262 |
| 23 | 58 | 563 | 9,420 | 663 | 2,340 | | | 381 | 320 |
| 24 | 100 | 340 | 9,120 | 1,530 | 3,440 | | | 208 | 381 |
| 25 | 173 | 226 | 8,520 | 2,680 | 3,720 | | | 140 | 281 |
| 26 | 300 | 173 | 8,040 | 3,040 | 3,400 | | | 132 | 140 |
| 27 | 300 | 140 | 7,440 | 2,800 | 3,040 | | 32 | 156 | 100 |
| 28 | 281 | 226 | 6,750 | 2,600 | 2,760 | | 32 | 125 | 89 |
| 29 | 262 | 381 | 6,000 | 2,340 | | | 32 | 173 | 84 |
| 30 | 226 | 1,050 | 5,100 | 1,890 | | | 25 | 89 | 78 |
| 31 | 226 | | 4,120 | 1,200 | | | 22 | 492 | |
| 1919-20. | | | | | | | | | |
| 1 | 58 | | | 199 | 4,800 | 446 | | | 68 |
| 2 | 41 | | 7,500 | 190 | 3,900 | 381 | | | 173 |
| 3 | 34 | | | 199 | 3,360 | 320 | | | 173 |
| 4 | 20 | | | 190 | 2,960 | 340 | | | 140 |
| 5 | 17 | | 8,580 | 199 | 2,880 | 402 | | | 156 |
| 6 | 14 | | 8,140 | 199 | 2,920 | 563 | | | 140 |
| 7 | 14 | | 7,760 | 262 | 2,800 | 770 | | | 140 |
| 8 | 20 | | 7,920 | 340 | 2,640 | 1,020 | | | 112 |
| 9 | 58 | | 7,760 | 430 | 2,530 | 1,380 | | | 112 |
| 10 | 663 | | 7,150 | 521 | 2,420 | 2,640 | | | 89 |
| 11 | 1,560 | | 6,280 | 612 | 2,100 | 3,500 | | | 424 |
| 12 | 2,250 | | 5,550 | 1,170 | 1,860 | 5,650 | | 469 | 208 |
| 13 | 2,640 | | 4,550 | 1,650 | 1,590 | 8,690 | | 340 | 164 |
| 14 | 2,680 | | 4,000 | 1,800 | 1,290 | | | 226 | |
| 15 | 2,320 | | 3,040 | 1,650 | 992 | | | 140 | |
| 16 | 1,770 | | 1,830 | 1,410 | 908 | | | 340 | |
| 17 | 1,350 | | 908 | 1,590 | 587 | | | 300 | |
| 18 | 1,290 | | 587 | 1,710 | 563 | | | 262 | 680 |
| 19 | 824 | | 492 | 1,770 | 539 | | | 226 | |
| 20 | 612 | | 381 | 2,070 | 539 | | | 140 | |
| 21 | 515 | | 320 | 2,680 | 637 | | | 125 | |
| 22 | 1,470 | | 262 | 3,180 | 852 | | | 123 | |
| 23 | 1,350 | | 244 | 4,300 | 1,260 | | | 140 | 964 |
| 24 | 1,170 | | 226 | 4,400 | 1,590 | | | 112 | 563 |
| 25 | 992 | 563 | 208 | 6,880 | 2,010 | | | 100 | 402 |
| 26 | 1,320 | 539 | 199 | 6,990 | 1,740 | | | 62 | 226 |
| 27 | 2,560 | 1,170 | 199 | 7,100 | 1,470 | | | 66 | 208 |
| 28 | | 1,590 | 208 | 6,990 | 1,110 | | | 49 | 156 |
| 29 | | 3,490 | 208 | 6,720 | 797 | | | 41 | 94 |
| 30 | | 6,660 | 199 | 6,500 | | | | 62 | 80 |
| 31 | | | 208 | 5,750 | | | | 49 | |

NOTE.—Stage-discharge relation affected by backwater from Mississippi River, discharge not determined, Mar. 17 to July 26, Oct. 28 to Nov. 24, 1919, and Mar. 14 to Aug. 11, 1920. Stage-discharge relation affected by backwater, mean discharge estimated, Dec. 1-4, 1919, and Sept. 14-22, 1920. Discharge interpolated on account of lack of gage readings, Jan. 9 and 10, 1920. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Big Muddy River at Murphysboro, Ill., for the years ending Sept. 30, 1919 and 1920.*

[Drainage area, 2,170 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off in inches. |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Per square mile. | |
| 1918–19. | | | | | |
| October | 300 | 4 | 76.1 | 0.035 | 0.04 |
| November | 1,050 | 68 | 281 | .129 | .14 |
| December | 10,900 | 118 | 5,040 | 2.32 | 2.68 |
| January | 3,280 | 219 | 1,240 | .571 | .66 |
| February | 3,720 | 140 | 962 | .443 | .46 |
| March 1–16 | 2,600 | 320 | 1,390 | .641 | .38 |
| August | 492 | 3 | 99.3 | .046 | .05 |
| September | 1,290 | 4 | 186 | .086 | .10 |
| 1919–20. | | | | | |
| October 1–27 | 2,680 | 14 | 1,020 | .470 | .47 |
| November 25–30 | 6,660 | 539 | 2,320 | 1.07 | .24 |
| December | 8,580 | 199 | 3,460 | 1.59 | 1.83 |
| January | 7,100 | 190 | 2,570 | 1.18 | 1.36 |
| February | 4,800 | 539 | 1,850 | .853 | .92 |
| March 1–13 | 8,690 | 320 | 2,010 | .926 | .45 |
| August 12–31 | 469 | 41 | 169 | .078 | .06 |
| September | 964 | 68 | 364 | .168 | .19 |

## MISCELLANEOUS MEASUREMENTS.

*Miscellaneous discharge measurements in Hudson Bay drainage basin during the year ending Sept. 30, 1919.*

| Date. | Stream. | Tributary to— | Locality. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | | | *Feet.* | *Sec.-ft.* |
| July 9 | Allen Creek | Swiftcurrent Creek | Near Many Glacier, Mont. | 0.24 | 3.2 |
| 28 | do | do | do | .11 | 1.7 |
| Aug. 15 | do | do | do | .00 | 1.4 |
| 23 | do | do | do | .02 | 1.0 |
| July 10 | Kennedy Creek | St. Mary River | do | ..... | 43 |

*Miscellaneous discharge measurements in Upper Mississippi River drainage basin during the years ending Sept. 30, 1919 and 1920.*

| Date. | Stream. | Tributary to— | Locality. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| 1920. | | | | *Feet.* | *Sec.-ft.* |
| Aug. 30 | Volga River | Turkey River | New highway bridge 1 mile from Elkport, Iowa, and ¼ mile above junction with Turkey River. | (a) | 118 |
| 1919. | | | | | |
| July 24 | Catfish Creek | Mississippi River | Illinois Central Railroad bridge at Rockdale, near Dubuque, Iowa, just above junction with North Fork and just below junction with South Fork. | (b) | 25.8 |
| 23 | Maquoketa River | do | Former gaging station at highway bridge, 7 miles above mouth of North Fork, and 6 miles northwest of Maquoketa, Iowa. | c 2.00 | 364 |
| Sept. 11 | do | do | do | c 1.82 | 309 |
| 10 | Wapsipinicon River | do | Highway bridge in Quasqueton, Iowa. | (d) | 49.7 |
| 1920. | | | | | |
| Nov. 18 | do | do | do | (e) | 1,030 |

a Distance from water surface to bottom of base plate of first column from right abutment, on downstream side of bridge, 16.52 feet.
b Distance from water surface to top of U-bolt in abutment on upstream side of railroad bridge, 10.20 feet.
c Gage height taken from old gage-scale, assuming a chain length of 29.60 feet.
d Distance from water surface to top of second post from left end of handrail on downstream side of bridge, 25.29 feet.
e Same reference point as used for measurement of Sept. 10, 1919: distance to water surface, 22.83 feet.

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